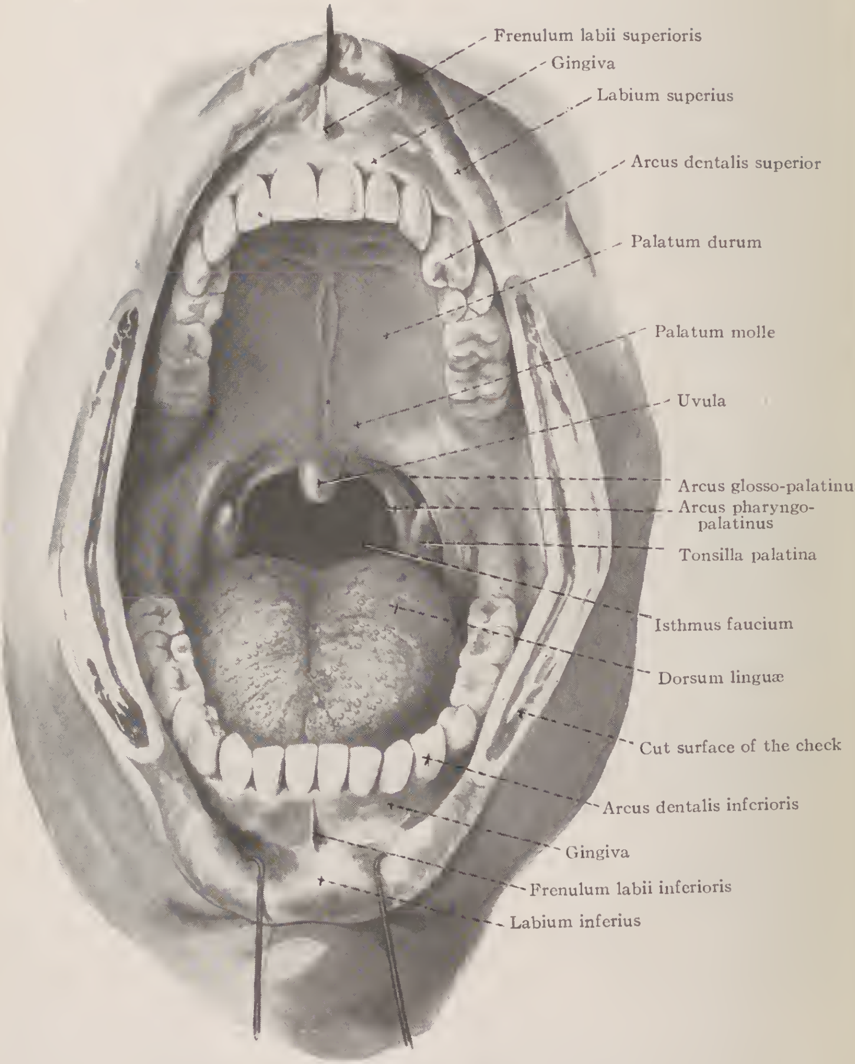
CLEFT LIP

AND

PALATE

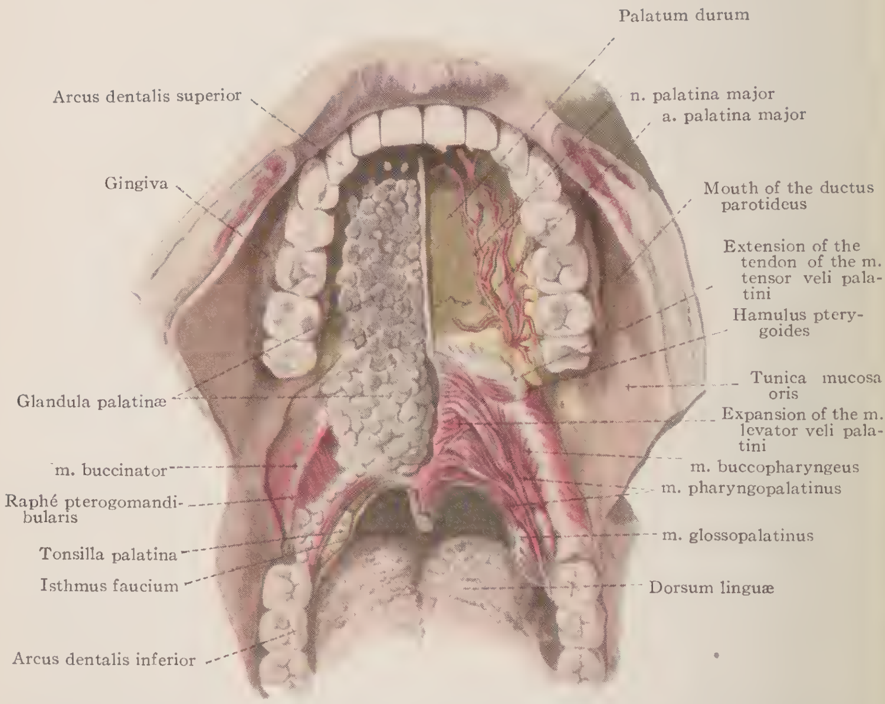
BROPHY

PLATE I

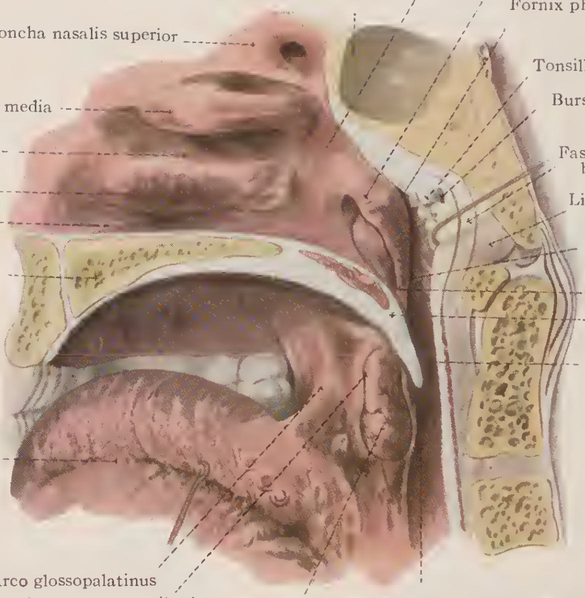


Cavity of the mouth, accurately portraying the palate with rugæ, median raphe and all of the associated structures. (*After Spalteholz.*)

PLATE II

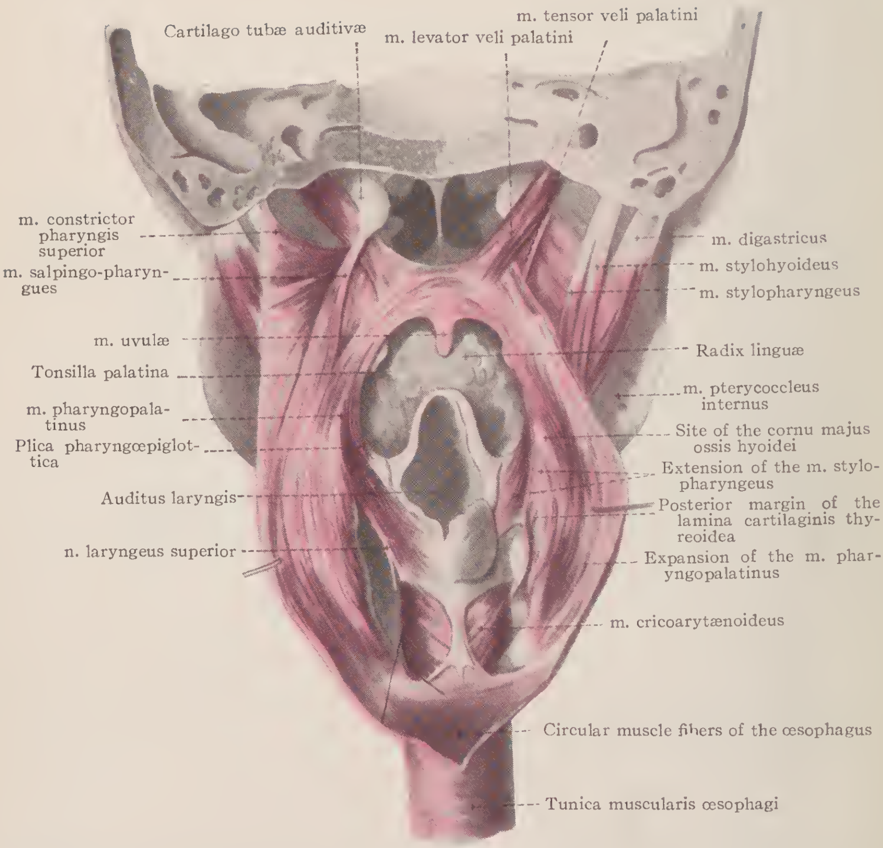


The palate, showing the posterior palatine artery and its branches together with the palatine nerve, the glands and muscles, tongue, tonsils, fauces, et cetera. (*After Spalteholz.*)



Vertical section of nares, palate, pharynx and associated parts. (*After Spalteholz.*)

PLATE IV



Posterior view of pharynx, showing tongue, epiglottis, muscles of the palate, tonsils, et cetera. (*After Spalteholz.*)

PLATE V

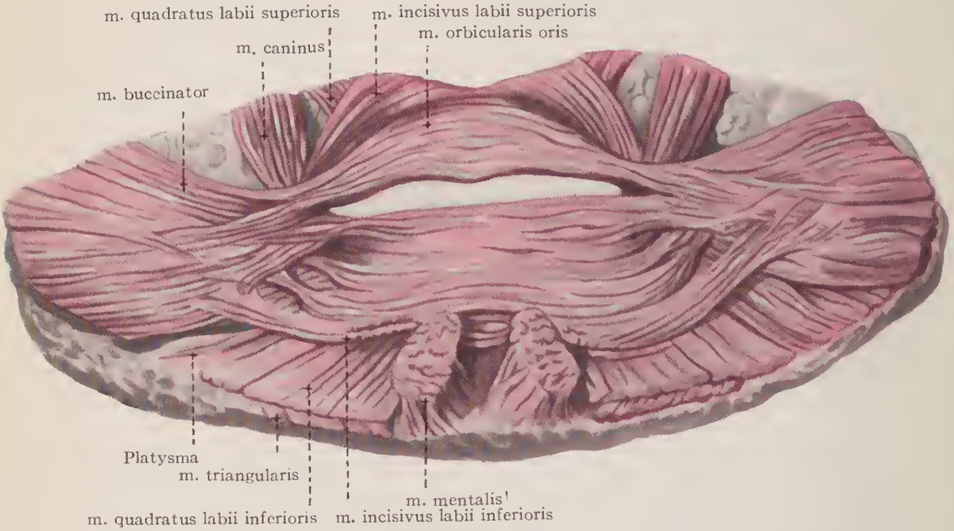


FIG. 1.

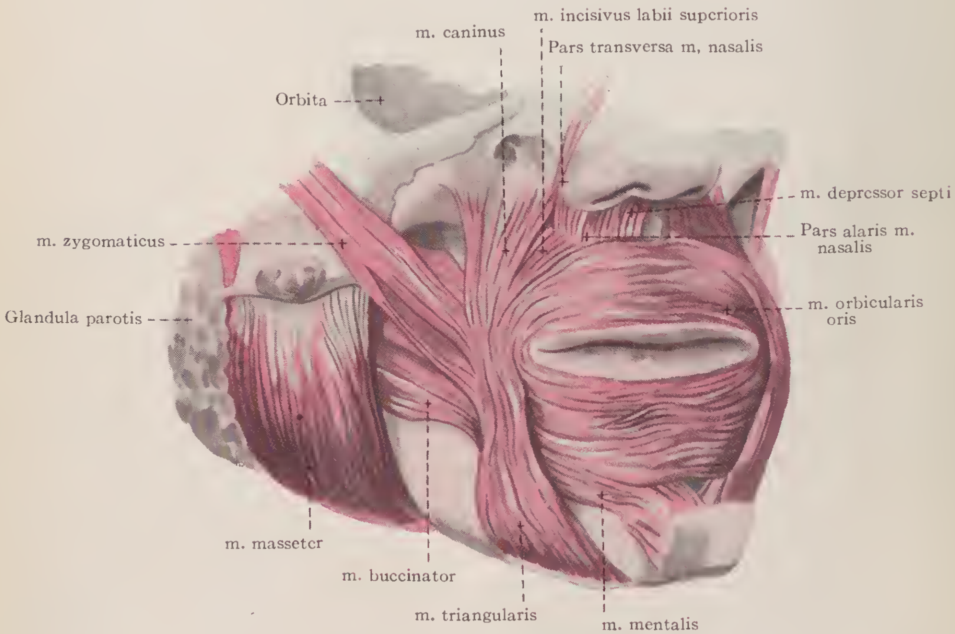


FIG. 2.

FIGS. 1 and 2.—The value of an accurate knowledge of the direction of the fibers of the muscles of the face is recognized by the plastic surgeon. Here we have illustrated the muscles and the direction of all their fibers, made accessible in this book, easily at hand to assist the surgeon in deciding on the lines of his incisions. (*From Spalteholz.*)

CLEFT LIP
AND
PALATE

BY

TRUMAN W. BROPHY

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WITH 466 ILLUSTRATIONS

AND COLORED PLATES

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DEDICATION

To my friend, MATTHEW HENRY CRYER, D. D. S., M. D., untiring student of the anatomy of the head and face, whose fruitful researches extending over half a century have recreated our knowledge of the structures of this region and established him as the highest authority in that field of scientific investigation, I dedicate this volume with fraternal love.

(The above dedication was written before the passing of Doctor Cryer).

T. W. B.

PREFACE

In 1915, my book on Oral Surgery was published. Many of the purchasers of the book were medical men interested in the field of oral surgery. It was published in two volumes and distributed in England during the war, and used for reference in all war hospitals.

The feature of the book, in the opinion of many surgeons, is the part devoted to Cleft Lip and Palate, and many letters from surgeons of prominence urging me to prepare a text book limited to these subjects have been received. I, therefore, have made use of material in my work on Oral Surgery, adding thereto the results of more recent investigations and inventions, with the improvements in technic that I have made.

In a report from the War Department on "Defects Found in Drafted Men" of 2,500,000 men examined, there were 1183 cases of cleft palate and 283 cases of cleft lip. Vermont showed the highest percentage of cleft palate, 1.55 per thousand. These figures relate only to men examined between 21 and 32 years of age. When we consider that women of the same age would probably show the same percentage; that in the younger stages of life the percentage is much higher, and further, the large number there are of both sexes over 32 years with palatal defects, we cannot but realize that the percentage of cleft palate patients is higher than was shown by the War Department.

In view of the frequency of cleft lip and palate and that it is the most conspicuous deformity known to the human family, it would seem that medical colleges generally would impart very thorough instruction on its surgical treatment, but it must be said that the American and European medical colleges, even of the greatest repute, give little or no information to their students upon this subject. The interns whom we have in our hospitals are among the very best men who graduate. They declare in many instances that not a word was taught on this subject. This is an explanation of the unfortunate condition in which we find so many patients upon whom these operations have been attempted. At the meeting of the Southern Minnesota Medical Society in November, 1920, a distinguished oral surgeon declared that a large percentage of the patients upon whom he operated were those who had been operated upon unsuccessfully by others. The responsibility for this appalling

record lies in great part to failure in medical teaching, and this is due to the fact, so I was informed by my publishers in 1915 that there were only six out of sixty-four leading Medical Colleges in this country which had chairs of Oral Surgery. Hence the general apathy of the medical practitioner in regard to this subject.

It is the desire of the author in sending forth this volume to arouse interest on the part of medical faculties and create an opportunity for their students to acquire a knowledge of the deformities of the palate, lip, and nose, together with the surgical procedures necessary for their correction.

All illustrations in this book are original except those credited to others.

I wish at this time to express my appreciation of the assistance rendered in the preparation of this volume by Sir Arthur Keith, the late Dr. Matthew H. Cryer, Drs. F. W. Belknap, C. N. Johnson, Oscar A. Strauss, Charles Schott, Eric Yule, W. H. G. Logan, Earle H. Thomas, William L Shearer, Albert D. Davis, J. W. Brennan, E. L. Cornell and Miss Bertha S. Pine.

T. W. B.

CHICAGO, 1923.

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INTRODUCTION

My experience in labio-palatal surgery has, no doubt, been like that of all others whose work has extended over a period of 40 years. There has not been a year within that period that I have not learned something new and profited thereby. During the last 30 years it has been my privilege to visit the principal surgical centers of the world and in most of them I have been invited to conduct clinics before the world's most celebrated surgeons. From these men I have learned much. I have studied with the greatest diligence, and in many cases have practiced their technic. In others I have recognized their weaknesses and studiously guarded against them.

In the field of cleft palate surgery, great improvements have been made in the last 5 years. Some of these have been minor, but many have been of major importance. Among the improvements which will bring to those who have cleft palates the great power of clear enunciation is the surgical technic which prevents the spreading of the arch. *The retention of the tuberosities of the maxillæ in a normal position is essential to the production of a normal soft palate, and a normal soft palate is essential to normal articulation.* This idea is emphasized in the text, but especial attention is called to it here because of its great importance, and the fact that the reasons why patients have not acquired perfect speech after palate operations has heretofore never been satisfactorily explained, so far as I am aware. Defective speech is not so much due to atrophy of the palatal muscles as has been claimed, but largely to the spreading of the tuberosities. Doubtless both factors have a bearing on the results, but to my mind the chief agency relates to a change in position of the tuberosities and the consequent shortening of the soft palate, resulting in such a tension of the tissues as to prevent closure of the palato-pharyngeal space, rather than to a condition solely of atrophy.

As in the case of the query sent out regarding the question of shock (published in my work on Oral Surgery in 1915 and also in this volume, p. 134) I have made inquiry of our most eminent surgeons and anatomists for opinions on my position regarding the spreading of the arch under certain conditions. In answer, Dr. George S. Huntington, Professor of Anatomy, College of Physicians and Surgeons, Medical Department of Columbia University—one of the most celebrated living anatomists—states:

"Dr. Brophy's mechanical conception of the forces involved in palatine closure appears to me very sound for the later developmental stages, when muscular action enters into the problem. In the earlier and critical embryological states, initiating the developmental process, I should consider the recession of mandible and tongue from the primary interpalatine position as the chief factor, and regard the active cell proliferation of the stomal surfaces and medial margins of the lateral processes as the principal active agent in furnishing material for filling the interspace left by the lingual recession and leading to the change from the oblique to the horizontal position of the palatal elements."

Another letter, from the Nestor of the surgical profession in the United States, Dr. Wm. W. Keen of Philadelphia, a man of international reputation, is as follows:

"I have been familiar, for many years, with your excellent work in connection with Cleft Palate.

"You have been the apostile of true surgery of this defect in that you have unquestionably shown that correct surgery of the bone is essential to the proper cure of the defect. Simply bringing together the soft parts anteriorly makes the cleft of the bones posteriorly still wider."

In this connection, attention is called to the statement made by Dr. Dean Lewis on page 133.

The expression "harelip" as applied to a congenital fissure of the lip, has long been recognized as a misnomer, because it does not resemble the lip of a hare. Therefore I have used the term *cleft lip* instead of harelip, and the desirability of the term "cleft lip" should appeal to all. Indeed, there seems to be little difference of opinion among surgical writers as to the advisability of using "cleft lip" instead of "harelip." However, at the meeting of the American Medical Association in St. Louis in May, 1922, the question of a new classification covering congenital clefts of the lip and palate was considered in the section of surgery and important suggestions were made in the report. The subject is open for further discussion and action.

My original work has been criticized by men who have admitted that they have never made use of my technic. They have intimated that my work was not justifiable, because, when the bones are approximated, so they say, there must be extensive necrosis under pressure of the lead plates that are employed. They have claimed that the mortality of the little patients is extremely heavy. They have even gone so far as to state that the closing of the cleft lip will produce the same result which follows the direct approximation and union of the bones by the use of wire sutures

and lead plates. This too, by critics who, in many instances, have had no experience with my instruments and my technic. Without the instruments I have designed, it would be impossible for me to do the work. Having operated upon 693 infants under six months of age during the past 6 years, I have not had a single case of necrosis follow, nor have I *ever* had a case of maxillary necrosis follow an operation on the bones of the palate. The experience of my confreres has been the same, one of whom has operated during the period of his practice upon at least 700 infants, with equally satisfactory results.

The large, curved needle which I have used for many years, I still employ. I have lately, however, made use of a straight spear to make openings through the bone, followed by a blunt, probe-like needle with the eye in the point, with which to carry the pilot sutures to place. In the hands of the experienced, the straight instrument is safer, as the operator can easily pass it between the teeth without disturbing them. The newer technic of palatal operations is fully described in the text.

Having stood alone in advocating and practicing bone surgery of the palate nearly 40 years ago, it is gratifying to know that nearly all the surgeons who have acquainted themselves with the technic and methods employed have heartily endorsed them and are practicing them.

In cleft lip work I have replaced all previously employed devices to relieve tension on the coaptation sutures with the Logan Traction Bow. The value of this appliance lies in holding the parts in quiet contact without interfering with the circulation and in providing easy access for cleansing the lip.

The value of the chapter on Speech Training, by the late G. Hudson Makuen is self-evident. Older patients who have acquired bad habits of speech before operations have been made may be greatly benefited by a careful study of the figures and by following out the instruction there given.

The chapter on Eugenics might be very greatly elaborated, but sufficient has been written to impress the reader with the influence of heredity in congenital deformities.

The importance of the preparation of these little patients for operation as set forth in the text by expert pediatricians, is recognized and appreciated by the surgeons who are fortunate enough to have had the benefit of their co-operation in the management of these cases.

I have endeavored to impress upon my readers the importance of adopting a classification and order of procedure in the treatment of cleft lip and palate:

First Stage: If the cleft of the palate is complete, if the bones are separated, bone surgery is essential to establish normality, preferably done before the fifth month.

Second Stage: Two months or later after the union of the bones, the lip is united.

Third Stage: The soft palate is closed from the sixteenth to the twenty-second months, just before the child begins to talk.

By proceeding in this way, the tissues can be best manipulated and anatomical normality most nearly approached.

CLEFT LIP AND PALATE

CHAPTER I

CLEFT LIP

Definition.—By the term Cleft Lip is meant a congenital fissure or fissures in the upper lip, due to failure of the superior maxillary and premaxillary processes to unite in early embryonal life. Cleft Lip, like Cleft Palate, is nearly always due to failure of union of well developed tissue. It has been called harelip from its supposed resemblance to the lip of a hare. However, the fissure is usually lateral to the median line while

Fig. 1.—Side view of median cleft lip, showing absence of lower portion of nasal bone. A rare deformity. (Author's practice.)

Fig. 2.—Cleft lip in median line, front view of same patient.

the lip of the hare presents the cleft in the center. In the human family, I have found only twenty-three cases on record, presenting cleft lip in the median line.[1] Seven of these cases have been in my own practice, and one in the clinic of Dr. Thomas L. Gilmer of Chicago.

[1] Of these, one is mentioned in Burke's Reference Handbook of Medical Sciences, another by R. C. Dun in the Transactions of the Society for the Study of Diseases in Children, London, 1905 (Vol. 6, p. 198). Another case is reported by Debraisieux in the Bulletin of the Belgium Royal Academy of Medicine, 1904. In this report, Debraisieux states that "median harelip is one of the rarest occurrences in the list of congenital anomalies." In a report of 555 cases of cleft lip by von Bruntz, not a case of median line cleft lip is noted.

In 1921 Sir Arthur Keith exhibited to me twelve specimens with median cleft lip, from the collection in the Museum of the Royal College of Surgeons, London.

FIG. 3.—Cleft lip showing only a slight notch.

FIG. 4.—Incomplete cleft lip on right side.

Classification.—Cleft lip may appear as only a slight notch—(Fig. 3), it may be complete or incomplete—(Figs. 4 and 5); it may be single—(Fig. 5); double—(Fig. 6); or complicated—(Fig. 7). (See page 195, a case of

FIG. 5.—Complete cleft lip on the left side with deflection of the nose to the right side. Patient also had a cleft palate.

FIG. 6.—Double cleft lip complete on both sides. The nose is flattened.

cleft palate extraordinary with cleft lip in the median line.) It may be partial on one side and complete on the other—(Fig. 8); it may be partial on both sides—(Fig. 9); or it may be complete on both sides—(Fig. 10).

A notch in the mucous membrane, extending into the skin, is the simplest form of cleft lip. It is usually uncomplicated. Occasionally we find

FIG. 7.—Cleft lip complicated with protruding premaxillæ.

FIG. 8.—Double cleft lip partial on one side and complete on the other.

congenital scars on the upper lip corresponding exactly to the position of the cleft lip. The nostril is dilated or flattened above the scar (Fig. 11).

FIG. 9.—Double cleft lip partial on both sides.

FIG. 10.—Double cleft lip with abnormally wide nostrils.

Complicated Cleft Lip.—A complicated cleft lip is one presenting a complete double fissure, with protruding premaxillæ. The prolabium is too short to form the central portion of the lip. (Figs. 12 and 13.)

Cleft lip is frequently, though not always, complicated with cleft palate. The palate may be cleft without involving the lip and the cleft lip may occur without involving the palate. Complete cleft lip, either single or

FIG. 11.

FIG. 12.

FIG. 11.—Late embryonal union of lip. This child had a perfect palate, but the lip had a broad, deep scar extending into the nostril. The latter had the usual expansion accompanying cleft lip. At operation the scar tissue was removed and nose remodeled.

FIG. 12.—Showing protrusion of premaxillæ, with complete cleft lip on the left side, partial on the right, and cleft palate. The vomer is separated from both palatal plates.

double, is attended by a deformity of the nose. If single, the nostril on the affected side is greatly broadened and flattened and the nose is deflected

FIG. 13.—Side view of patient with extreme protrusion of the premaxillæ.

FIG. 14.—Front view, same patient.

toward the opposite side (Fig. 15). In complete double cleft lip, both nostrils are abnormally wide, the nose flattened, and the center of the

lip is abnormally short and usually projects forward with the premaxillæ in some instances beyond the end of the nose (Fig. 16). In certain complications, the cleft may extend from the border of the lip upward beyond

FIG. 15.—A broad flattened nostril and badly operated single cleft lip. The nose is deflected toward the opposite side.

FIG. 16.—Double cleft lip. Unusual protrusion of premaxillæ and segment of upper lip with cleft palate.

FIG. 17.—Oblique facial cleft, complete into palpebral fissure on left side. From specimen in the London Hospital Museum. (*Blair.*)

the ala of the nose, as high as the inner canthus of the eye (Fig. 17). These defects are rare. They may be single or double.

Etiology.—The etiology of cleft lip is closely associated with that of cleft palate, for which see page 88. Fissures of the lower lip will be considered later. Cleft lip occurs with equal frequency in the male and female. In seventy-five per cent. of all cases of single cleft lip, the fissure appears on the left side.

When to Operate.—The literature of this department of plastic surgery is confusing to the student seeking for instruction as to the best time in life to operate. In the chapter on Cleft Palate I point out the nature and extent of that deformity in its many aspects and the importance of pursuing a course of treatment with the end in view of correcting the defect and establishing, as far as possible, a normal relation of the separated bones in very early infancy and prior to the operation for the closure of the cleft lip. In carrying out the work as outlined, therefore, the lip should not be operated on until after the bones have been approximated, followed by union, and sufficient time allowed for the patient to be prepared for the second stage, the lip operation. I would arrange the dates for these two operations as follows:

Order of Operations.—In treating cleft lip, complicated with cleft palate, when the bones are involved, the first step should be to unite the separated bones. The operation on the bones should preferably be done between the third week and fourth month by the author's method of using lead plates and wire sutures. The lip operation is performed from six weeks to three months subsequent to the operation on the hard palate, always keeping in mind that the patient has no ailment that would contra-indicate an operation. Many authors teach that the operation on the lip should be made as soon after birth as the condition of the child will permit. After examination of a great array of patients for whom operations have been made I am more and more convinced as time passes that the error of closing the lip before the cleft bones are united, should have placed upon it the seal of surgical disapproval. I therefore condemn the practice of closing the cleft lip before operating on the cleft *hard* palate (Figs. 159, 160 and 161).

The correction of the deformity of the palate, lip and nose may best be accomplished by first closing the bones, which to a very great extent corrects the defect of the nose (Figs. 18 and 19), bringing it into the median line of the face, when the next operation, the closing of the lip, removes the external deformity. If, however, the nose is flattened or otherwise defective (see p. 127) the great advantages of closing the cleft bones first are self evident. Besides the open lip admits of greater room in which to work on the palate. Reviewing experiences in the passing of the years, I am convinced that the best time to operate on the soft palate is just before speech is attempted—about the eighteenth month. At that time

the tissues are thicker and stronger and we can rely on better results. This completes the production of a palate nearly or quite normal.

Infants having cleft lip, without the complication of cleft palate, should be operated on within the first month if the physical condition of the child will admit. The deferring of the operation, however, in case the health of the child is not favorable, will do no harm as the lip operation may be done at any time. The parents naturally appeal to the surgeon to correct the lip deformity as soon as possible.

FIG. 18.—A cleft of the palate with cleft lip on the left side. The nose is diverted to the right, and the left nostril is extremely broad and flat.

FIG. 19.—Same patient with hard palate closed and nose brought in the median line.

Preparation of the Patient.—The preparation of the patient, the arrangement of the operating room and table and the respective duties of anesthetist, assistants and nurses are all described in the chapter on Cleft Palate and are applicable here as well. The face of the patient should be thoroughly cleansed, especially the lips and nose, before the operation is begun. While we may not be able to place the skin and mucous membrane in an absolutely aseptic state, we should approach asepsis as nearly as possible.

THE PRINCIPLES UNDERLYING THE TREATMENT OF CLEFT LIP

Old Operative Methods.—Formerly little attention was paid to the enormously dilated nostrils in complete cleft lip. The deformity of the face, by reason of the nose being drawn to one side in single cleft lip, was not considered. The lip was quickly and badly united by freshening the edges, by adjusting pins and forming figure eight sutures over them (Fig. 20); by sewing the parts together with strong sutures; or wires with buttons placed upon the sides of the lip, with a view to preventing the parts from separating (Fig. 21); or by Hainsby's compress (Fig. 22). Fig. 23 shows the method devised and employed by the author in 1885 to correct the

flattened nostril and relieve tension from the lip. This was abandoned long ago since unnecessary scars were made by its use. Upon the lip oftentimes gauze was placed, held down by adhesive straps from cheek to cheek, or if gauze was not placed over the line of sutures, at least iodoform or boric acid powder was sprinkled over the lip including the line of union and covered with adhesive plaster extending from one ear to the other.

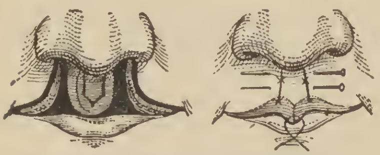

FIG. 20.—Operation for double cleft lip. Now obsolete. (*Shepherd.*)

Examination of the parts revealed that too frequently no attempt was made to produce a nostril that would approach normality. Instead of having a superabundance of tissue along the vermilion border, making provision for slight shrinkage after the edges had united, a deep notch was permitted to remain. A large majority of the cases we meet in adult life now present evidences of operation as above described (Fig. 15).

To operate on single cleft lip, to bring the nose into its proper position, to construct a nostril which will correspond in form and size to the normal nostril, to approximate the skin so as not to leave cicatricial tissue intervening, to operate so as to leave no notch in the lip nor depression along

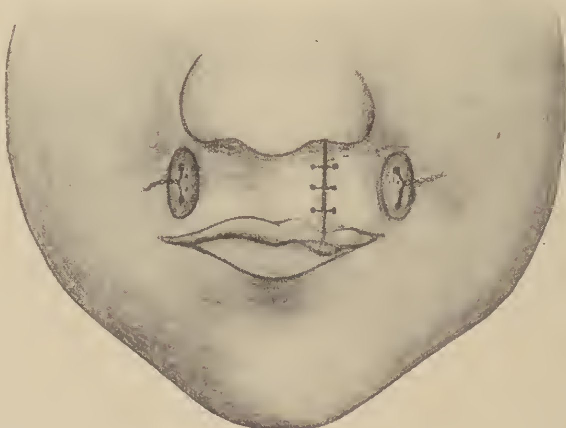

FIG. 21.—Lead plates fixed by silver wires devised by the author in 1885 to relieve the tension on coaptation sutures in cleft lip operations. These sutures always leave scars and for this reason have been abandoned years ago for the Logan traction bow. (See Fig. 58.)

the line of sutures after union and perfect healing have taken place, to have mucous membrane meet only mucous membrane and skin meet only skin, to have the vermilion border on the operated side of the lip the same as on the other side, to have the upper lip a little more prominent than the lower one and not too short from angle to angle of the mouth—to

achieve such a result is to make one of the most delicate, difficult and successful operations in plastic surgery.

FIG. 22.—Hainsby's compress formerly used to compress the cheek to relieve tension on coaptation sutures. Now obsolete. (*Garretson.*)

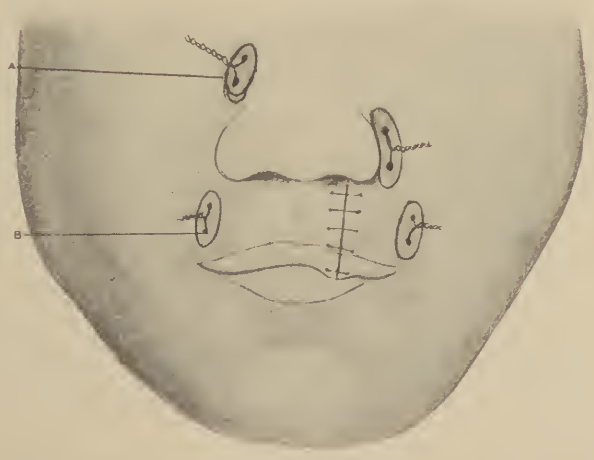

FIG. 23.—Author's method of placing wire and lead buttons in lip and nose to relieve tension and correct the abnormally broad flattened nostril. This method was abandoned in 1887.

Suture Material.—Heavy sutures, wires, buttons, and harelip pins transfixed with figure eight sutures are not only clumsy and extremely

painful to the patient, but nearly always leave deep scars at the points of entrance and exit. The wires with buttons are open to the same objec-

Fig. 24.—Author's steel clamps and lead plates used to bring flattened nostrils in place. The clamps are made in three sizes and in different degrees of stiffness.

tions; the heavy silk sutures are but little better and should never be used.

The closure of a cleft lip may always be accomplished by the use of horse-hair sutures alone. The great difficulty in procuring strong, light,

Fig. 25.—Clamp ready to be applied.

reliable horse-hair sutures is now overcome. We are able to get such sutures in three sizes, heavy, medium and light. The advantage of using

horse-hair with a Hagedorn needle in cleft lip work is manifest. There are no suture scars left when healing has taken place and, after the sutures are

FIG. 26.

FIG. 27.

FIG. 28.

inserted, the retention appliance, the Logan lip fraction bow, see Fig. 58, which I shall describe later, will insure the union of the parts with the formation of the least possible amount of cicatricial tissue.

The Nose Deformity.—In the article on the treatment of congenital cleft palate in early infancy, I point out the importance of removing the facial deformity, in part, by approximating the separated bones. Prior

FIG. 29.

FIG. 30.

FIG. 31.

FIG. 32.

FIGS. 26 to 32.—A series of pictures showing the results obtained in a case of cleft lip and palate. The lip had been previously operated. Fig. 26 illustrates the clamp applied. *A*, Adhesive plaster; *B*, lead plate between two layers of adhesive plaster; *C*, pin carried through the lead and external layer of plaster; *D*, steel clamp over the nose. Figs. 27 and 28 illustrate the condition of the nose and lip prior to the operation. Figs. 29 and 30, the nose and lip after operation. Figs. 31 and 32, cleft of the palate in same patient, before and after operation.

to operating on a cleft lip the nose should receive consideration. The nostrils should be given proper form and size. It will be remembered that in bringing the maxillæ into proper relation, we move the nose from the

oblique position, which it almost invariably assumes in single cleft lip and widely separated cleft of the bones, and place it in the median line of the face where it should be. Thus we have done much to overcome the deformity of the face. Now, the problem before us is to operate in such a

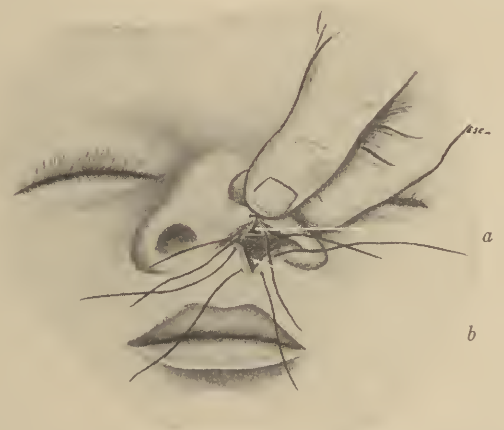

FIG. 33.—Shows method employed in correcting a flattened nostril and an irregularly pointed nose. *a*, Nostril incision; *b*, lip incision.

way as to give to the broadly dilated and flattened nostril its proper form, remove only sufficient tissue to freshen the edges to be approximated, and to treat the lip so that all the parts will be brought into normal anatomical

FIG. 34.—Operation completed.

relations as nearly as possible. Care must be taken to draw the ala of the broadly expanded nostril in so as to form the naso-buccal groove between the ala of the nose and the cheek. The material and methods at our command will usually enable us to secure this result.

It should be the aim of the surgeon to employ means to bring the flattened nose into normality without using sutures or other appliances which leave scars. The instrument (Fig. 24), which I devised to avoid scars, serves its purpose well. Two lead plates are used, No. 17 American gauge, 1 inch × 2 inches (the length varies somewhat with the size of the patient), and in the nose end of each plate a small steel pin with a head is fixed. The pin is three-eighths of an inch long. The plates are incorporated in adhesive plaster as follows: one strip is made long enough to reach from the ear nearly to the nose. The lead plate is placed on the non-adhesive side of the strip. The nasal end of this strip is carried up over the nose end of the lead and over the pin. A second strip of adhesive plaster, equal in size to the first, is placed adhesive side down on the lead plate and first adhesive strip.[1] This securely fastens the lead between the two strips

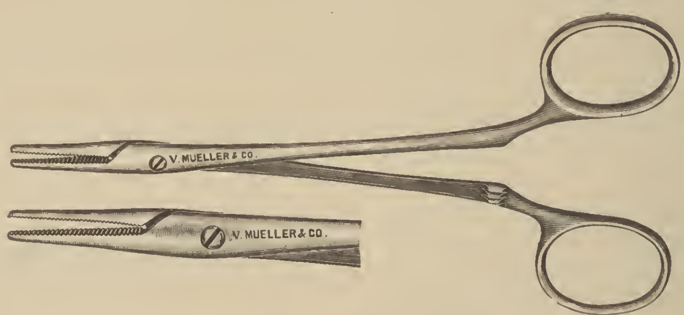

Fig. 35.—Fine hemostatic forceps.

of adhesive plaster. The small steel pin penetrates both layers (Fig. 25). The steel clamp, of which there are three sizes and degrees of stiffness, is then placed over the nose and the notch ends embrace the pins in the lead plates. The two plates are thus moved toward the median line of the nose. The ala of the nose is firmly held in its proper position, thereby correcting the deformity (Figs. 26 to 32) without the use of wires and plates which (as we pointed out before) always leave facial scars.

If the border of the lip is good and the nostril only is flattened, the following procedure may be employed to give the nostril its proper form: in order to make the nose narrow at its base, a V-shaped section of tissue is removed from the lip side of the nostril (Fig. 33 *b*). A strong horse-hair suture is placed well up in the nose, the wound closed and the flattened nostril assumes its proper form. One or two horse-hair sutures are placed in the lower part of the wound. In these cases the tip of the nose on the defective side is usually lower than normal. The other nostril is normal and higher. In order to overcome this defect, it is necessary to remove

[1] Aug. 1st, 1921. I have recently procured plaster that is adhesive on both sides. This has great advantage over the plaster which is adhesive only on one side.

a small piece of nasal cartilage. A V-shaped incision (Fig. 33, *a*) is made just within the nostril near the junction of the ala and septum. The

FIG. 36.—Front view of patient with imperfectly united cleft lip, nose depressed on the right side and diverted somewhat from the median line.

FIG. 37.—Patient with head inclined backward to show the shape of the nostril and end of nose, the columna and point of nose.

FIG. 38.—Right nostril lifted up with tractor, showing right lateral cartilage which draws the right ala of the nose downward and inward.

FIG. 39.—Manner of removing section of cartilage to give nostril normal form.

apex of the V is located anteriorly. The wound is then closed with horsehair sutures. This draws the tip of the nostril up (Fig. 34).

FIG. 40.—Application of Logan Traction Bow to relieve tension and prevent cutting out of stitches.

FIG. 41.—The defect corrected.

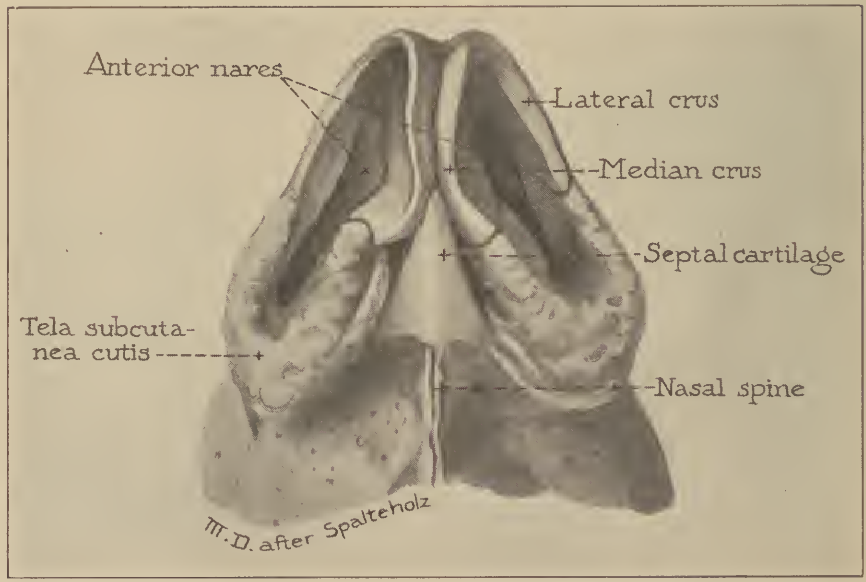

FIG. 42.—The alar cartilages. It will be seen that the cartilages of the nose are so related to each other that when an incision is made downward and kept slightly to the side of the cartilage of the deformed nostril, this nostril may thus be released from its union with the median line. It may then be so sutured that the depressed nostril will be advanced forward enough to overcome the defect.

Hemorrhage in Cleft Lip.—It has been noted that in operations for uniting the separated bones, hemorrhage was so slight that the operator was not in any way disturbed, but in operations upon the lip, unless every precautionary measure is observed, the hemorrhage may be alarming and imperil the life of the patient. Before freshening the edges of the lip, rolls of gauze should be carried into the nostril on the affected side so as to prevent blood from running into it. Little dressings may be placed under the lip to catch any blood that may pass toward the mouth. In addition

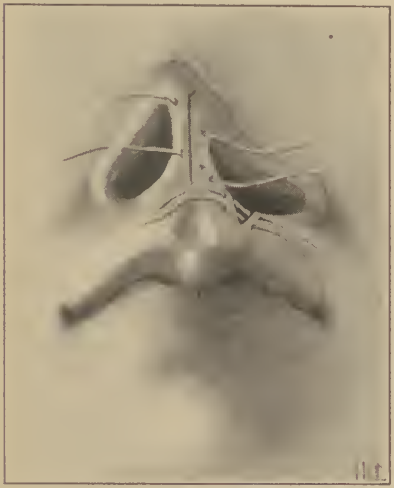

Fig. 43.—Operation devised by Ericsson in 1885 and published in his book.

Fig. 44.—Operation completed, with very satisfactory result.

to the aromatic spirits of ammonia, one dram to the ounce, which should be always at hand to resuscitate a patient, a solution of one part to 10,000 of adrenalin chloride should be ready to use if necessary for the suppression of capillary hemorrhage. Formerly, before freshening the edges of the lip, it was my practice to place in the corners of the mouth, clamps, having their beaks covered with rubber tubing, so as to arrest the flow of blood through the labial arteries. While the flow of blood was prevented, the reaction and swelling of the parts, subsequent to the operation, in some instances was so great that I have abandoned the use of clamps. By the use of suitably formed mosquito hemostatic forceps (Fig. 35), the vessels may be taken up as exposed by the passage of the knife and hemorrhage prevented.

SIMPLE NOTCH OPERATIONS

To remove a slight notch in the lip (Fig. 3), an incision is made as illustrated in Fig. 45. The quantity of mucous membrane and muscular tissue necessary to give the lip the proper fullness should be carefully studied and the incision made accordingly. The lip is always thicker on the short side. The knife therefore should be directed downward on the short side, (A), to obtain a smaller quantity of muscular tissue. To secure a larger amount it should be directed upward on the long side (B). Fig. 46 illustrates the sutures in place. The tissues have been carried downward and the notch removed.

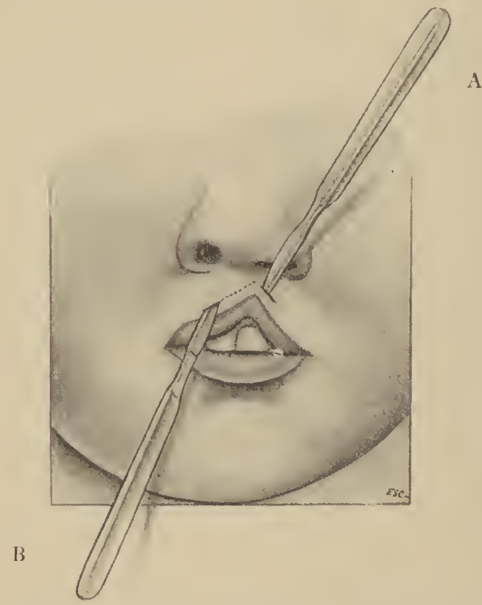

Fig. 45.—The proper position of the knives for making incisions to remove notch in upper lip.

Figs. 47 to 50 illustrate the method of everting and rolling out the mucous membrane and muscular tissue of the inner part of the lip to overcome the notch.

SINGLE CLEFT LIP OPERATION

As about seventy-five per cent. of cases of cleft lip are on the left side the description given herewith is for that side. The application, of course, is the same to both sides.

First Step.—The first step to be taken in the operation for single or double cleft lip, complete or incomplete, is to seize the tissues at the junction of the lateral wall of the nostril and the upper extremity of the fissure with self-retaining, fine toothed tissue forceps (Fig. 48). The

handles of these forceps are two and one-half inches longer than usual. The advantage of the forceps of this length is appreciated when used.

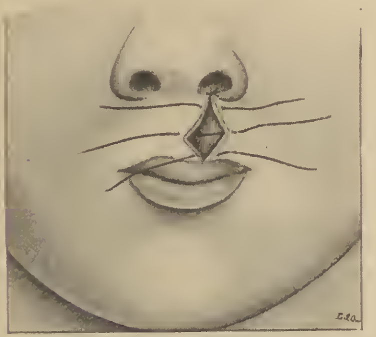

FIG. 46.—Nelaton incision for lengthening mucous membrane to correct line to correspond with opposite side.

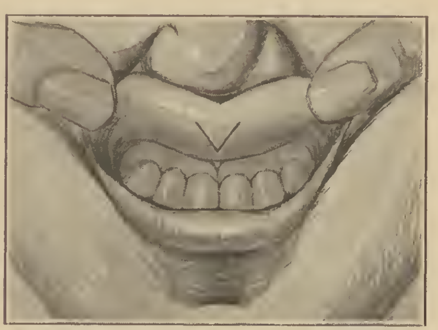

FIG. 47.—Author's method employed to remove notch in upper lip resulting from a poor cleft lip operation. V-shaped incision is shown. This extends two-thirds of the way through the muscular tissue.

Remove the skin and mucous membrane a short distance up in the nostril, with a Bard-Parker knife with pointed blade, carrying the incision down about one-fifth of the length of the upper lip (Fig. 51). In the meantime the lip is held firmly between the thumb and fingers of the left hand, thus preventing the escape of blood until the vessels have been secured by fine hemostatic forceps.

FIG. 48.—Fine tooth tissue forceps.

Second Step.—The next step is to freshen the tissues adjoining the nasal septum, being careful to leave a broad surface, which is met, when the sutures are fixed, by the surface first freshened. Instantly, when these surfaces are freshened, the small hemostatic forceps are employed to arrest hemorrhage.

Third Step.—Here it becomes necessary to study the relation of the upper and the lower lips. The object is to produce a normal lip without any depression or notch. It is essential now to decide how much tissue is needed from each side of the fissure to produce the normal lip. After this has been satisfactorily settled, the next step may be taken. After some experience accurate adjustment can be made without the use of a compass or other means of measuring the borders of the fissure. The compass as proposed

and used by Thompson has a place in the hands of some operators. It is no doubt a valuable aid in outlining the extent of incisions. From a long experience before its use I find I do not require it.

Fourth Step.—The operator, standing at the head of his patient, makes pressure upon the lip on the left and shorter side, with thumb and finger of the left hand. He then passes a knife through the substance of the lip, carrying it upward and inward so as to meet the lower terminal point of the nostril incision (Fig. 51). This incision should be kept far enough from the vermilion border to enable him to gain sufficient tissue to meet

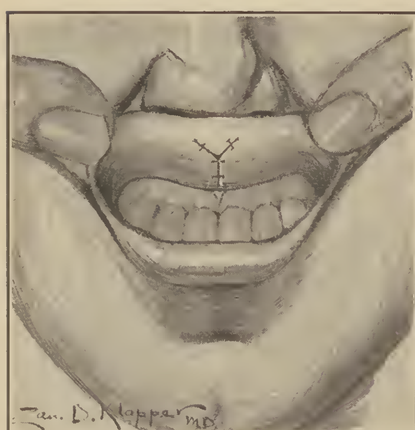

FIG. 49.—Shows manner of introducing sutures. The notch is thus removed.

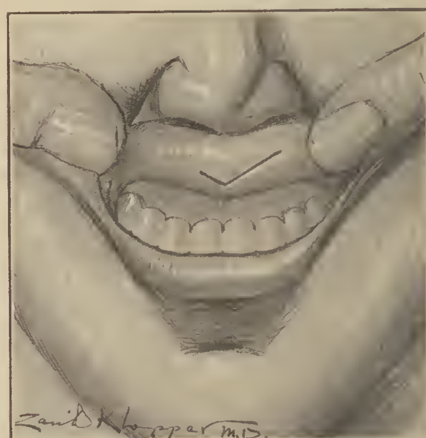

FIG. 50.—If the notch is on the left side, as is usual, the incision should be longer on that side since a greater amount of tissue must be lifted to overcome the defect.

the flap of the opposite side and prevent the great notch in the lip so often seen after these operations (Fig. 15). The knife should be slanted as in A, Fig. 45.

When this flap is made, the upper end is seized immediately by the hemostatic forceps (the thumb and finger pressing upon the lip in the meantime) and turned downward by the assistant while the surgeon makes use of his small hemostatic forceps to catch the labial arteries.

Fifth Step.—Having freshened the surfaces of the left side and made the flap also, the fifth step is to make a flap on the right and longer side. It must be borne in mind that a greater amount of tissue should be utilized on the right side than on the left, since it is necessary to get the pendant portion of the lip in the median line. To do this it is essential to have the greater part of the mucosa brought downward from the under part of the long side of the lip. The knife is passed, as in making the opposite flap, through the substance of the lip, carried obliquely upward to the terminal

point of the nasal incision (Fig. 51) and should be slanted as in B, Fig. 45. The upper part of the flap is seized with the hemostatic forceps, moved downward by the assistant, while the surgeon, still pressing upon the lip to prevent the flow of blood, catches the arteries with hemostatic forceps. Any other small vessels are treated in the same manner, thus preventing hemorrhage.

If the left nostril is, as usual, abnormally broad and flattened and does not come over readily to be united to the freshened surfaces at the septum of the nose, an incision may be made beneath it (Fig. 52). This is carried far enough back over the maxillary bone and beneath the cheek to relieve the tension and thus enable the operator to bring this ala of the nose into

Fig. 51.

Fig. 52.

Fig. 51.—Shows the method of making incisions to obtain the correct amount of tissue. The knife on the right side of the fissure cuts in such a manner as to obtain a larger amount of muscular tissue because it is necessary to give the central portion of the lip normal fullness. On the left side a smaller amount is utilized.

Fig. 52.—Illustrates the extent of the incision made to free the tissue in order to bring the flattened nostril into proper position.

proper relation with the other. The clouded area shows the extent of the incision to separate the muscular tissue from the periosteum. This procedure was first proposed by Dr. Charles Mayo.

To facilitate the adjustment of the freshened surfaces the flaps are taken up by forceps and approximated. Care should be taken that the forceps seize only the muscular tissue (Fig. 53). If placed on the mucous membrane or skin, trauma follows. A strong *temporary* silk suture is placed well up into the substance of the lip, through both flaps and on the inner surface, and a surgeon's friction knot made, drawing the tissues into contact (Figs. 66 to 68). The surgeon now has an opportunity to observe the relation of the deformed nostril to the normal one.

Sixth Step.—The next step is to introduce the nostril sutures. Horse-hair is employed. The surgeon's knot should be used, the parts drawn together, and care exercised in the shaping of the nostril. The ala of the

FIG. 53.

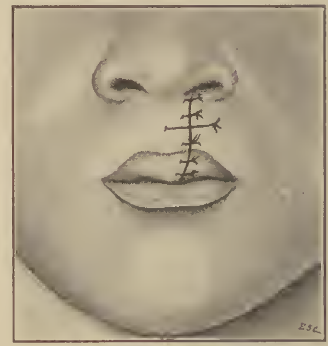

FIG. 54.

FIG. 53.—Shows the incisions completed and the flaps moved downward, ready for approximation. It will be observed that the mucosa on the long side of the lip extends down lower than on the short side. By this method, mucous membrane is approximated with mucous membrane and skin with skin. No notch is left in the lip after it unites and the central part is pendant. The forceps seize the muscular tissue on the under side of the lip.

FIG. 54.—Horse-hair sutures introduced in single cleft lip. The long suture re-inforces the others.

nose may be too high to correspond with that of the opposite side, or it may be too low. The nostril may be too large; if so, sufficient tissue should be taken away to bring the nostrils into harmony. The sutures are

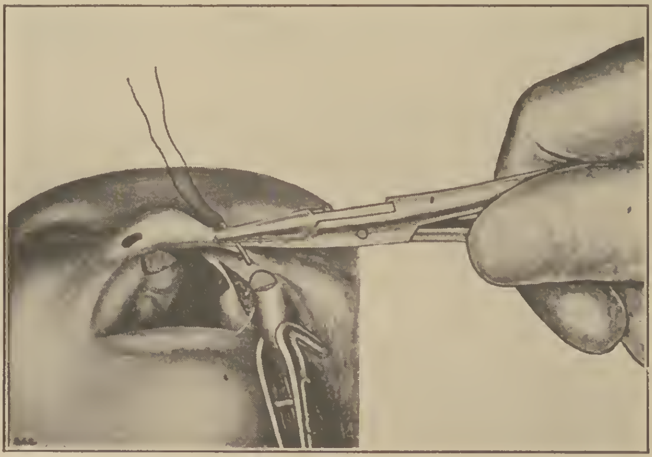

FIG. 55—Needle-holder with needle and suture; showing method of passing the first stitch. (*Berry and Legg.*)

adjusted, but left in such a way as to be tightened from time to time, during the course of the operation, if necessary, and to admit of the adjustment of other sutures for the construction of the lip (Fig. 69).

Preventing Depression in the Lip.—To prevent the formation of a depression in the lip from the nostril downward, the freshened surfaces may be split in such a way as to permit the skin to move forward and outward. This will prevent the drawing of the skin downward, as often occurs, forming a groove leading from the nostril to the vermilion border of the lip. This always may be avoided by a slight splitting of the tissues midway between the skin and mucous membrane throughout the entire length of the freshened edges of the flap (Fig. 64). Interrupted sutures of horsehair, sometimes doubled, are used, the first knot adjusted, but not the second, and the sutures held back by hemostatic forceps. No knot should be fixed finally until all sutures are adjusted down as far as the

Fig. 56.—Result following incision in the cheek for the repair of cleft lip.

Fig. 57.—Same case properly operated. Four months after operation.

vermilion border, on reaching which, the tying of the sutures should begin, first tying the suture in the nostril. Prior to this, however, the plug of gauze which was inserted before the operation, should be removed or forced upwards so as to give better access to the tissues within the nostril. Having tied the upper suture, the others are tied from above downward. *Approaching the vermilion border, great care should be exercised to approximate skin with skin and mucous membrane with mucous membrane.* The flaps that have been made must receive attention before the adjustment of the sutures through the skin at the vermilion border. There always is some slight superabundance of skin, which must be removed before the suture is adjusted so as to have skin meet skin and mucous membrane meet mucous membrane (Fig. 54).

After uniting the lip from the nose to the mucous membrane, adjust the flaps in such a way as to have a slight excess of tissue in the line of union to

provide for the shrinkage which will take place. To give the lip the fullness of mucous membrane and muscular tissue necessary to make it normal, make incisions through the mucous surfaces beneath, crowding the muscular tissue downward in the center, thus producing the pendant appearance so essential to a natural lip (Fig. 65). A knowledge of the technic, how to manipulate the mucous surfaces of the lip and bring downward and forward a sufficient amount of muscular tissue, is essential to enable the surgeon to produce the best results. The horse-hair sutures should be continued through the mucous membrane and beneath the lip in such a way as to give it prominence where prominence is required, and to remove excess of tissue wherever it appears.

Seventh Step.—Suturing completed, the temporary silk suture removed, the next consideration will be to protect the parts from injury or from the possibility of separation. Concentrated compound tincture of benzoin should be applied to the approximated parts, over all the sutures, both inside and outside of the mouth.

LOGAN LIP TRACTION BOW

The construction and adjustment of a satisfactory appliance for holding the edges of the newly united lip in quiet contact and to prevent the stitches from pulling out following cleft lip operations has always been earnestly desired and innumerable devices have been constructed for this purpose. No matter how carefully and efficiently the suturing be done, the crying of a child may separate the lip. The hazard of failure in this respect may be avoided by the use of this traction bow (Fig. 58).

Hainsby's Compress, one of the first to attract attention of the profession, was found to be clumsy in its adjustment, was oftentimes displaced by the patient and, for these with other reasons, was finally abandoned. Harelip pins, which were thrust through the lip and fixed with figure eight sutures, caused unsightly scars and so they were abandoned. I have seen wire sutures carried through from cheek to cheek and fixed with lead buttons, a procedure which failed to attract much attention, because of the scars made upon the cheeks. Adhesive strips over the lips retained secretions in contact with the freshly united surfaces, oftentimes followed by infection and further maceration of the skin. They, too, were abandoned. Adhesive strips carried around the mouth so as to draw the angles of the mouth toward the nose are still used, but not with the satisfaction desired by the surgeon. I have used rolls of cotton in glove fingers, placing one in adhesive strips on each side of the sutured lip, lacing the

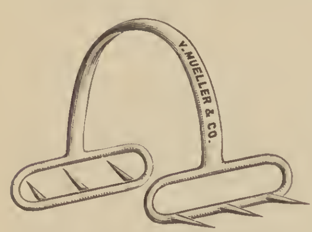

Fig. 58.—Logan Lip Traction Bow, fully described in the text.

parts together by fixing dressmaker's hooks to the rolls and using silk sutures to fasten the hooks together. Lead plates, fixed by silver wires, devised by the author in 1885, left scars and for that reason were given up. The author's adhesive strips devised for relieving tension have been used with success, but I am satisfied that in some cases the pressure upon the lip interferes to some extent with the circulation, and for that reason I have sought other means for holding the parts in coaptation.

Fig. 58 shows a device which has been thoroughly tried out and which has been found to be free from all of the objections that have been raised against the other devices. This is Dr. W. H. G. Logan's invention and it is not open to the slightest objection. Tension on the lip may be increased or diminished at will, and this is a feature that has not been possible with any other. It not only holds the lip in a state of quiet

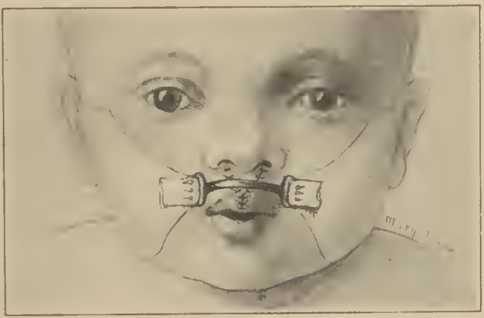

Fig. 59.—Logan Lip Traction Bow in place.

without pressure against the vessels, but at the same time allows access to all its surfaces so that they may be kept absolutely clean and the process of repair may be watched from the time of operation until the sutures are removed. The horsehair sutures may be removed in from three to five days after operation, thus avoiding suture scars, while the appliance remains and the edges of the wound will not be disturbed in the slightest degree.

Other Operations.—In surgical works on the treatment of cleft lip, many illustrations of various methods of freshening edges and bringing the parts in contact appear. An experience extending over a period of forty years, in dealing with these conditions almost every day, has led me to believe that many of the methods illustrated have no practical value. The incisions carried around the ala of the nose, as in Dieffenbach's method, the zig-zag incisions of Simon, and Geraldi's and König's methods seem unnecessary. The carrying of incisions into the cheek in making these operations (Fig. 56), or removing crescent-shaped masses of tissue from the lip, Fig. 72 cannot be too strongly condemned. Disfiguration of a patient, following such incisions, cannot be completely overcome. The single-

flap methods of Mirault and Owen (Fig. 60), so nearly alike that there is little or no difference in the technic, are to be recommended in certain cases, according to the judgment of the surgeon. This method consists of one deep incision and the making of a single flap reaching over to be united with the opposite side, as shown in the illustration. The amount of tissue is sufficient to enable the surgeon to form a good lip, but there

Fig. 60.—Mirault and Owen operation for cleft lip.

is none to spare. In the description of these operations, apparently little attention is given to the construction of a nostril and the formation of a normal nose.

DOUBLE OR BILATERAL CLEFT LIP

Classification.—This deformity may present itself in two forms: Simple and complicated (Figs. 6 and 7). In the simple form we find a double cleft lip with the premaxillæ in normal or nearly normal position. These fissures may be, as previously described, partial or complete, extending through the entire lip, or they may be only notches in the vermilion border (Fig. 61). The prolabium is too short to form the entire central portion of the lip. The complicated form will be taken up in detail later.

The closure of double cleft lip is, by no means, a minor operation. It is an extensive and most exacting one and requires a thorough knowledge of the anatomy of the parts, a prompt control of hemorrhage and the greatest expedition in completing it. To approximate the edges of the skin so as to avoid the formation of a mass of scar tissue, and to secure a correct vermilion border without a notch remaining, is to plan and execute with the highest degree of accuracy. More than this, the flattened nose and dilated nostrils must receive the first consideration. The tip of the nose must be raised at a later operation, usually.

The Nose in Incomplete Double Cleft Lip.—In the description of the technic of the single cleft lip operations, the steps to be employed have been carefully outlined for producing a good nostril. Here we have two nostrils to deal with, so we must employ the methods there described to narrow the nose and bring the alæ into normal position. It may be necessary to dissect up the soft parts covering the bone lateral to and beneath the wing of the nose in order to move the flattened nostril into correct position (Fig. 52). *We must endeavor to produce a naso-buccal groove*, rolling the nostril

in somewhat, that we may procure that appearance nearly always observed in the normal organ. It must be remembered that the description above deals only with uncomplicated cleft lip. If the premaxillæ are separated either on one or both sides these bones must be united before the lip operation is performed. The same applies to cleft palate complications.

Fig. 61.—Incomplete double cleft lip (see also Figs. 352 and 353 in Cleft Palate).

In operating on incomplete cleft lip, we remove as much tissue as is necessary to reduce the broad nostril to normal form. In so doing, we produce temporarily a complete cleft lip, after which we proceed as elsewhere described.

DOUBLE CLEFT LIP OPERATION

The steps taken in doing this operation are as follows:

First Step.—Plugs of gauze are inserted in each nostril, as described in single cleft lip, and the edges of the fissure are freshened well up into the nostril (Fig. 62). The mucous membrane is removed from the central part of the lip. The lip is seized with the thumb and fingers of the left hand, the exposed blood-vessels are caught and hemorrhage controlled. An incision is made then through the substance of the lip upward and inward to the lower terminal point of the nostril incision (Fig. 63). The knife should be directed through the lip so as to bring downward on both sides a much broader surface of mucous membrane than skin. This is

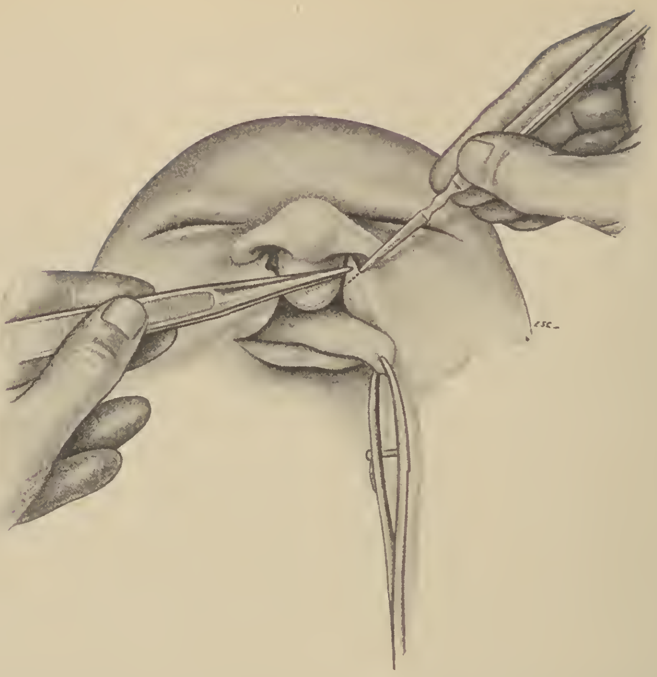

FIG. 62.—Incision used by the author in correcting flattened alæ of the nose in single or double cleft lip operations. The tongue is held forward to prevent it from dropping back into the pharynx and obstructing respiration.

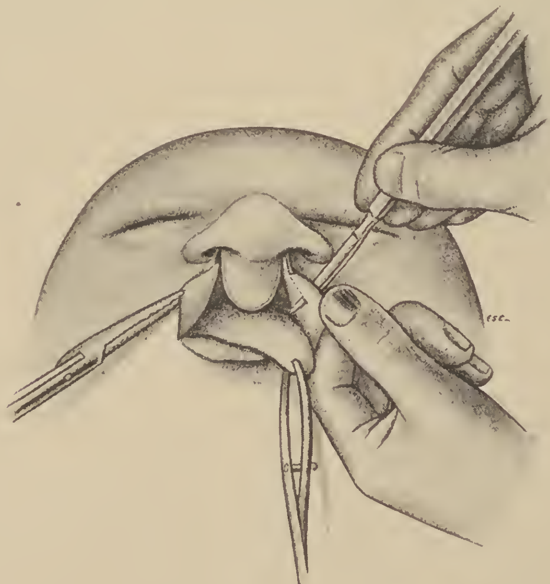

FIG. 63.—Proper position of knife in making flap. The mucous surface is shown here.

done for the purpose of rolling out the middle portion of the mucous membrane to give the lip the proper fullness in the median line after union has taken place. The end of the flap is seized with forceps and held by the assistant while the operator controls the hemorrhage with hemostatic forceps. These forceps are allowed to remain on the flaps until nearly all the sutures are placed and tied. Before removing them the forceps are twisted so as to effectually arrest hemorrhage by torsion.

Second Step.—The opposite side is treated in the same manner, the vessels being taken up promptly as soon as exposed. In order to prevent

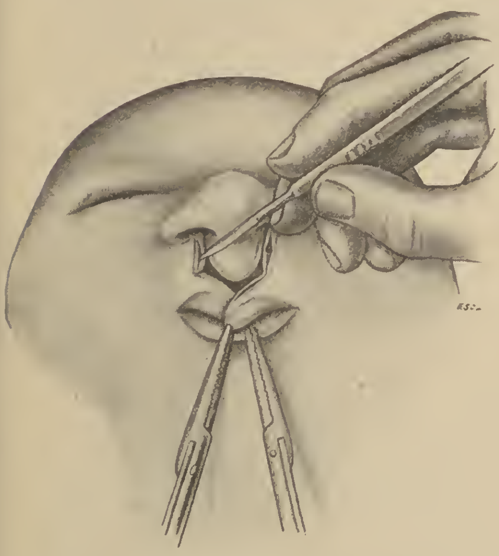

FIG. 64.—Flaps held in position by forceps. The freshened surfaces have been split, so as to avoid the formation of grooves in the skin.

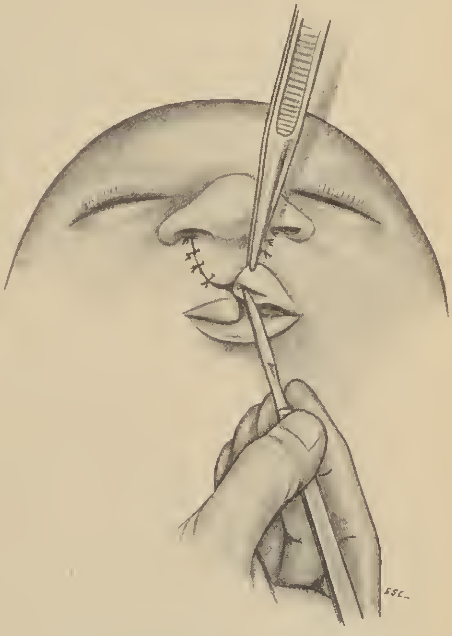

FIG. 65.—Incision used to give proper fullness to the center of the lip.

a groove forming from the nostril downward after the parts are sutured, the central part of the lip, as well as all of the lateral freshened surfaces, should be split so that the skin and mucous membrane may be more widely separated (Figs. 64 and 65).

Third Step.—We now have the surfaces all freshened, ready for suturing. To facilitate this and the approximation of the edges of the fissures, a strong temporary silk suture is carried into the mouth, through the muscular tissue almost to the skin, including both sides of the fissure, and just through the tip of the central portion of the lip (Fig. 66). The suture is drawn up by means of the surgeon's friction knot and the separated tissues brought in contact (Fig. 67). We do not secure the knot, since we may

wish to change it in the further development of the operation, but the double turn of the knot will hold it quite satisfactorily until the horse-hair

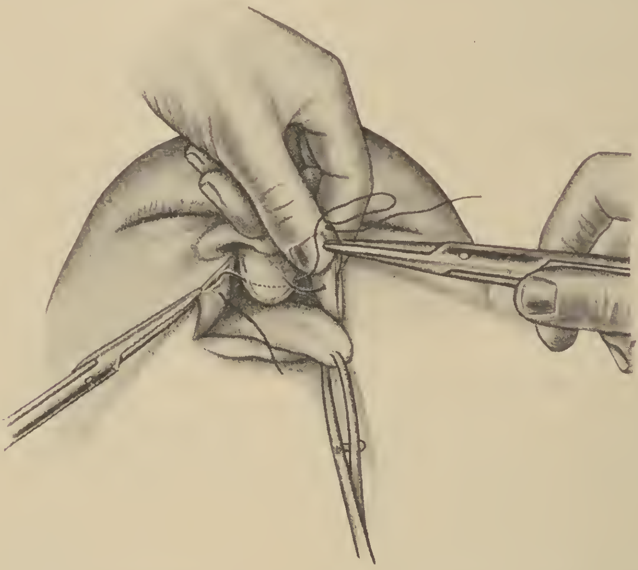

FIG. 66 —Author's temporary suture used to hold separated tissues together while introducing the lip sutures.

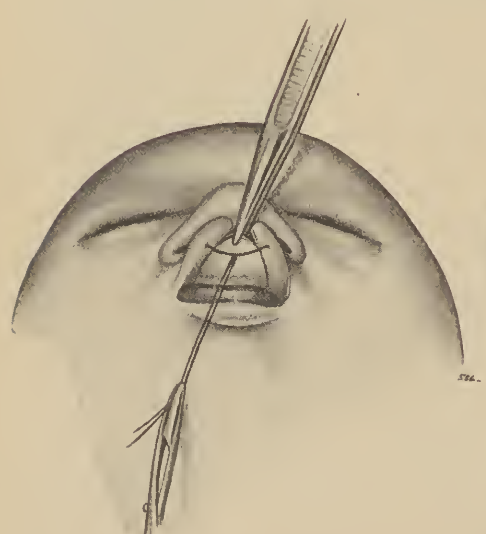

FIG. 67.—Temporary suture tied and separated tissues brought in contact.

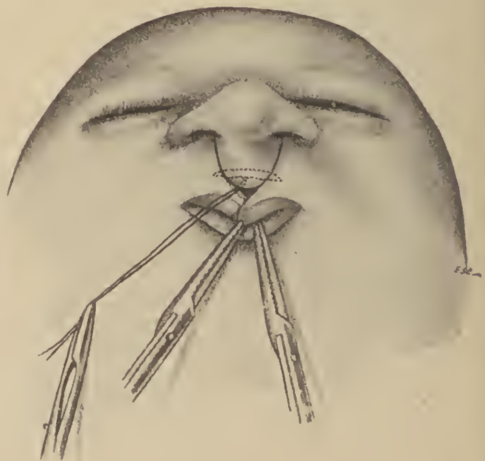

FIG. 68.—Skin surface of lip showing tissues brought in contact and temporary suture beneath (dotted lines).

sutures are adjusted (Fig. 68). Should the knot slip, we may hold it firmly by seizing it with forceps. Now we remove the plugs from the nos-

trils and introduce a horse-hair suture on a small, curved Hagedorn needle well up into the nostril, including all the tissue freshened except the inner

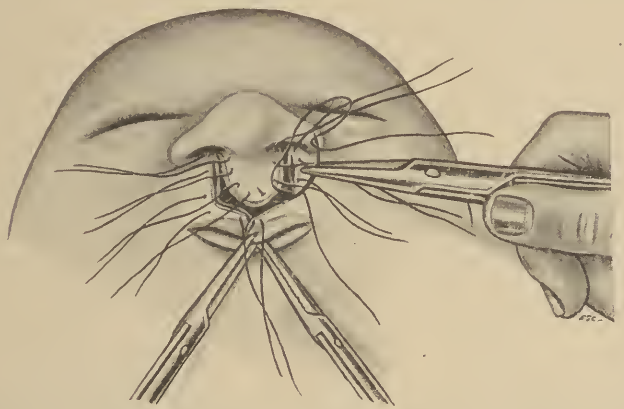

FIG. 69.—Method of introducing interrupted horse-hair sutures. Small hemostatic forceps used to secure correct relation of edges of the lip.

mucous membrane. The tail ends of the sutures are grasped with hemostatic forceps, and interrupted horse-hair sutures are introduced

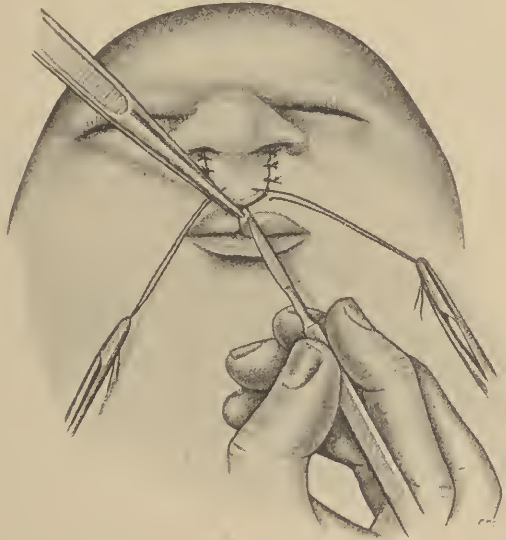

FIG. 70.—Method of removing superabundant skin on flap to prevent the overlapping of mucous membrane. This insures contact of skin with skin and mucous membrane with mucous membrane. All the muscular tissue should be preserved and used to give to the lip normal fullness and to prevent a notch. The skin and mucous membrane may be sutured over the muscular tissue to accomplish this end.

down to the terminus of the central portion of the lip. Only one turn of the knot is made until all the sutures on both sides are inserted to this

point. The angle of the incision is brought in contact with the central part of the lip by introducing sutures, as shown in Fig. 69, and carried into the substance of the central part of the lip. This is repeated on the opposite side. The part below the central portion is then sutured. At this point we stop and tie all sutures beginning at the nose.

Fourth Step.—We have still one of the most interesting and important steps to take in *producing a correct vermilion border of the lip.* This requires a great deal of painstaking effort. The flaps brought down are sufficient in quantity to produce a most beautiful cosmetic result, but the most common error of the operator is in making the lip too long. The mistake lies in failing to manipulate the tissues in such a way as to prevent the formation of a notch in the median line after the parts are united.

FIG. 71.—Method of joining mucous membrane in the mouth.

It is necessary to take into consideration the fact that a superabundance of skin has been brought down to the median line. Some of it must be removed to prevent the skin running into the mucous membrane, thus disfiguring the lip (Fig. 70). Having removed enough of the skin to avoid its over-lapping the mucous membrane, the needle is inserted into the skin at the border of the membrane and carried through the tissues of the opposite side, with an exit corresponding exactly to the point of entrance of the needle. A sufficient number of sutures are put in to secure perfect coaptation of the tissues. Only the first knot is tied so that necessary changes may be made easily. We are certain now of bringing skin in contact with skin only and mucous membrane in contact with mucous membrane.

The sutures in the skin are left. The mucous membrane and inner part of the lip remain to be sutured later. That portion of the tissues which has been within the grip of the beaks of the hemostatic forceps, which

includes a very little, should be cut off since it has been crushed by the forceps and is of no value.

Fifth Step.—The center of the lip, the most pendant part, is sutured with horse-hair, and a few sutures are inserted on the under portion of the lip within the mouth (Fig. 71). The temporary silk suture previously introduced to draw the tissues together during the insertion of the horse-hair stitches is cut and removed as it is no longer required. I have found retention sutures very valuable as auxiliaries to the coaptation sutures already placed. It will be observed three sutures have been adjusted to reinforce the coaptation suture—the first near the nose (Fig. 73) extends through

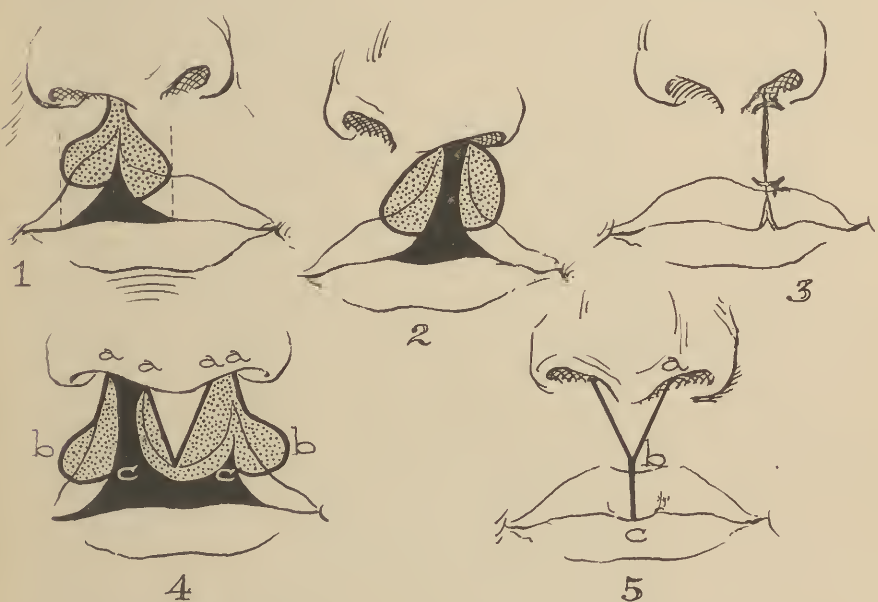

Fig. 72.—1, Outlines of incision in a *Rose* operation for partial lip cleft, in which there is also a spreading of the nostril of that side. By the vertical dotted lines it is seen that the incisions extend laterally as far as the widest part of the cleft. It will also be seen that the length of each cut within the vermilion border of the lip is the same. If the lengths of the two curved incisions were measured, it would be found that they were of the same length on each side. These are the three important points in designing the incisions of a *Rose* operation.

2, Incisions for a *Rose* operation of a complete *single* cleft.

3, After making the incisions for a *Rose* operation the *ala* is replaced with one suture and the newly pared borders are approximated and put on the stretch by a tension suture placed at the mucocutaneous border.

4, *Rose* operation for double harelip incomplete on one side.

5, Completed *Rose* operation for double harelip. (*Blair.*)

The sacrifice of such an amount of tissue as is illustrated in these figures makes the upper lip too short from angle to angle of the mouth. It is not in harmonious relation with the lower lip; it recedes abnormally; the lower lip, therefore, protrudes. Altogether, the expression of the face in profile is abnormal. (*T. W. B.*)

the greater portion of the muscular tissue of the lip. The second suture is carried on a full curved needle through the lip flap on the vermilion border. It is started on the right side five lines from the border of skin

and carried upward and through the central portion of the lip, so that it makes its exit in a corresponding position in the left flap. This completely closes any separation which may exist between the prolabium and the flaps. The third retention is placed just above the vermilion border in the flaps. It is inserted in such a manner as to include the muscular tissue. It must not pass through the mucous membrane in the mouth. All the knots should be tied at the point where the needle entered. *This completes the operation.*

The error of making the lip too long is due to having, in the first place, a long central portion with large flaps added to its lower part. The central portion should be made short enough to give it, after the flaps have been adjusted, the correct length. Two things, therefore, must be considered: First, the length of the central portion; second, the size of the flaps to give

FIG. 73.—All sutures have been placed and the operation is completed. It still remains necessary to adjust the Logan lip traction bow (see Fig. 58).

the lip its proper length. To relieve the strain upon the stitches and to prevent them from cutting out and allowing the parts to separate, the device before described (Fig. 58) should be employed. It can be relied upon to hold the parts in contact until union takes place.

COMPLICATED DOUBLE CLEFT LIP

General Considerations.—This form of double cleft lip may be complicated by the premaxillæ extending forward, which, in some instances, carry the central part of the lip far beyond the end of the nose (Fig. 16). In such a complication, the double fissure in the lip is usually complete,

though occasionally there may be a band of integument connecting one side of it with the median line (Fig. 74). The management of this

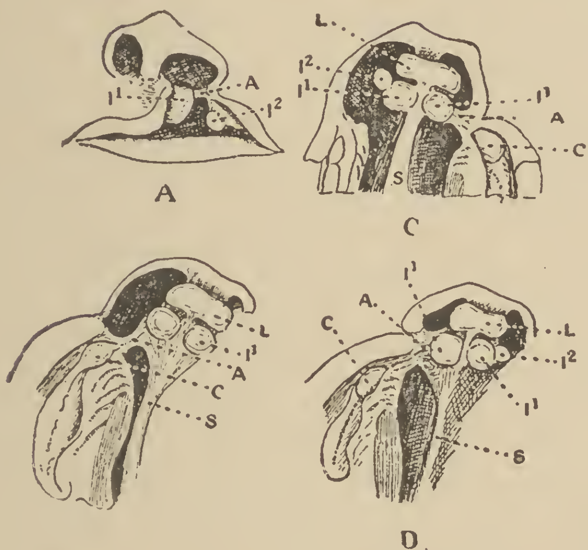

FIG. 74.—Four specimens of cleft palate showing various degrees in the development of the bond between the premaxillary, maxillary and lateral nasal elements. *A*, The bond or bridge of tissue crossing the cleft. l^1, Central incisor sac; l^2, Lateral incisor sac; *C*, Canine sac; *L*, Median part of upper lip; *S*, Septum of nose. (*Keith.*)

deformity requires the bringing of the premaxillæ in proper position by making an oblique incision through the vomer, carrying the prominent

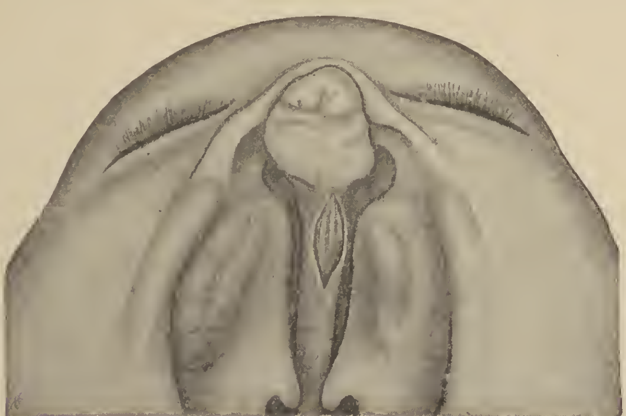

FIG. 75.—Shows the method of splitting the vomer so as to move the premaxillæ backward (*Bardeleben.*)

premaxillæ back into position, as described on page 179, and fixing them there by means of silver sutures (Figs. 305, 306, 307). The writings upon

this subject, which express disapproval of wiring the premaxillæ to the maxillæ, are, I believe, from the pens of authors of limited experience in the treatment of these congenital defects or, possibly, from those unfamiliar with the technic required to establish a solid, bony arch by bringing the misplaced premaxillæ into the position where they belong. Once placed in proper relation with the maxillæ, freshened and firmly wired together, a solid bony arch will be secured.

The vomer may be split from the premaxillæ backward about 2 cm. (Fig. 75). By pressing backward on the premaxillæ the split portions of the vomer spread, or, a V-shaped piece of the vomer may be removed through this incision. This permits the premaxillæ to come in contact with the maxillæ.

Operation.—The method of procedure in the closure of bilateral cleft lip, after union of the malposed vomer and the premaxillæ has been secured, does not differ in any sense from the operation for simple bilateral cleft lip. The adhesive straps applied to the face and fixed with the Logan Lip Traction Bow (Fig. 58), hold the parts firmly in position and prevent them from separating. Moreover, the wound may be kept absolutely clean.

AFTER TREATMENT

The nose may be plugged with a roll of iodoform gauze saturated with concentrated compound tincture of benzoin, if thought best, to prevent the exit of secretions upon the wound. The wound should be cleansed thrice daily, using sterile applicators. The first applicator should be saturated with boric solution and the second one should be dry. It is essential to the success of these operations that the lip be kept thoroughly clean and dry. The accumulation of mucus which soon becomes incrusted is often the cause of failure of union. In any event the surface under the crust becomes excoriated causing unnecessary scarring. The nasal plugs should not remain longer than three days. The patient's hands should be fixed with long pasteboard cuffs so that he cannot disturb the parts (Fig. 124).

Some operators make use of rubber tubing for draining the nose. Frequently the secretions escape around the tube thus defeating its purpose. I have not found the rubber tubes desirable or necessary.

The retention appliance is permitted to remain nine days. The horsehair sutures are removed on the fourth to seventh day. In some cases a twenty per cent. solution of argyrol may be used on the under surfaces of the lip as a prophylactic measure against infection. However, infection of the lip is not at all likely to occur if the precautions here outlined are observed carefully.

COMPLICATIONS FOLLOWING DOUBLE CLEFT LIP OPERATIONS

Nose Defects.—It will be seen, following nearly all operations for double cleft lip, especially when the premaxillæ are prominent and require moving back into position, that when union of the parts has taken place and the sutures and retention appliance are removed, the nose is flattened more or less having been drawn inward by the central portion of the lip (Figs. 93, 94, 95 and 96). To overcome this defect, which is very great sometimes, I devised an operation for lifting the end of the nose and carrying it forward to a normal position.

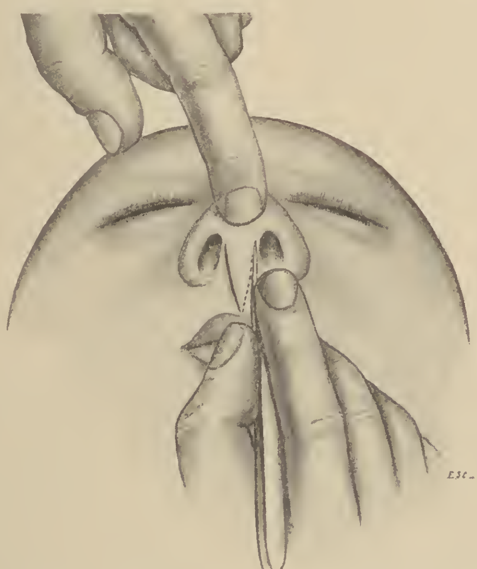

FIG. 76.—First step in author's operation for elevating the flattened nose.

Flattened Nose Operation. First Step.—This operation is made by starting an incision at the anterior extremity of the medial crus of the great alar cartilage of the nose and carrying it posteriorly between this cartilage and the anterior nasal spine of the maxilla, thence downward into the substance of the lip about two-thirds of its length (Fig. 76). A corresponding incision is made on the opposite side, always keeping close to the medial wall of the nostril, but not penetrating it. This long V-shaped incision should be deep enough to include, in the part to be lifted up, muscular tissue extending half-way through the lip. The tissue should be raised from the central part of the lip and a careful dissection made of the covering of the nasal septal cartilage, when the entire mass should be lifted upward, exposing to view the anterior extremity of this cartilage (Fig. 77).

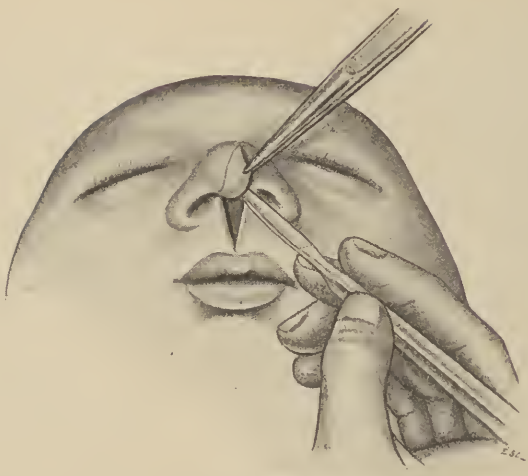

FIG. 77.—Elevating the tissues by dissection, care being taken not to pass the knife through the mucous membrane.

FIG. 78.—Dotted lines show the course of horse-hair suture through the cartilage of the nose beneath the skin. On tying, the suture lifts the end of the nose forward thus removing the flattened appearance and giving the nose the proper form (see Figs. 93 to 96).

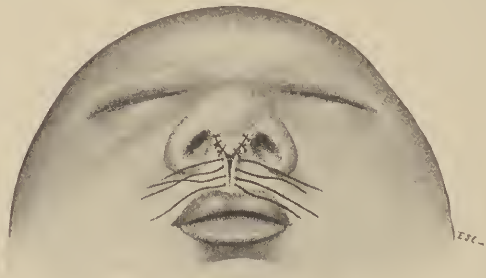

FIG. 79.—The end of the nose has been raised and the sutures are placed to approximate the edges of the wound in the lip.

Second Step.—A strong double horse-hair suture is passed through the end of the cartilage and through the uplifted flap in such a way as to force

FIG. 80.—Condition of patient in Figs. 80 to 87. Aged two months when first operated.

FIG. 81.—Profile view.

FIG. 82.

FIG. 83.

FIG. 82.—Profile of patient upon her return at 12 years of age. Palate in perfect condition with a full complement of teeth in a regular arch and her enunciation normal. Steps were taken at this time to elevate the nose as described on pages 37 and 40.

FIG. 83.—Front view; border of lip somewhat irregular with nostrils abnormally dilated.

the mass of tissue forward (Fig. 78). The lateral crus of the greater alar cartilages is carried forward at once and the point of the nose raised to

FIG. 84.

FIG. 85.

FIG. 84.—Nose held in elevated position, with author's device after operation as described in Figs. 76, 77, 78 and 79.

FIG. 85.—Front view, with appliance in position. It will be seen that the sutures are in the center of the lip. Referring to the series of operations illustrated by Figs. 93, 94, 95, 96, it will be seen that this operation was performed in the same manner. In this operation, the center of the lip was moved downwards so as to overcome the little notch which is visible in Fig. 83.

FIG. 86.—The operation completed. The flattened nose is elevated to the proper position and the depressed lip has the desired prominence.

FIG. 87.—Front view, after the operation was completed.

the desired extent. Having fixed the point of the nose by suturing through the cartilage and soft parts, the opening made in the lip may be closed quickly by two or three interrupted horse-hair sutures (Fig. 79).

FIG. 88.—Front view of girl eleven years old with an extensive deformity of the nose, lip and palate with protrusion of the premaxillæ.

FIG. 89.—Front view showing double cleft lip.

The series of pictures shown in Figs. 88 to 96 demonstrate a case complicated by protrusion of the premaxillæ and complete cleft of the hard and soft palates. The results of the operations are here well shown.

FIG. 90.—Complete cleft of the palate. The premaxillæ are separated from and protrude beyond the maxillæ.

FIG. 91.—Same patient, showing the cleft in palate closed, the premaxillæ in correct position, the cleft lip united and normal.

FIG. 92.—Tension straps used following closure of the lip. Now replaced by Logan Traction Bow.

FIG. 93.—The flattened nose could not be prevented when the protruding premaxillæ were brought in contact with the maxillæ.

FIG. 94.—Result following author's operation of elevating the nose after previous operations have been completed.

Contraction and Recession of Upper Lip.—The practice, which has been resorted to not infrequently, of excising the premaxillæ and closing the fissure of the lip invariably leads to contraction of the maxillæ and

FIG. 95.—Front view of patient showing flattened nose.

FIG. 96.—Front view after all operations were completed.

recession of the upper lip, followed by a most conspicuous deformity (Figs. 97 and 98). Sometimes the lip is greatly contracted, though the premaxillæ are not removed (Fig. 99). The upper lip contraction gives to

FIGS. 97 and 98.—Result following the excision of the premaxillary bones. Note contraction of upper lip and protrusion of the lower.

the lower lip a greater relative prominence and thickness than it would have had if the premaxillæ had been preserved and the lip united over them. The excessive development of the lower lip is due to failure of

direct occlusion with the upper lip and to over-lapping. Extensive contraction and recession of the upper lip, with a corresponding protrusion

FIG. 99.—Badly operated lip. Corrected by removing V-shaped piece from lower lip and inserting it in the upper.

FIG. 100.—After operation.

FIG. 101.

FIG. 102.

FIG. 101.—Upper contracted lip split in the center for the reception of V-shaped piece from the lower lip. In this patient the premaxillæ had been excised (see Fig. 107). The palate was normal otherwise. The result of the lip operation was not good. The operation is described in the text. Author's patient.

FIG. 102.—Photograph of patient during operation. Removing tissue of the lower lip and uniting it to the median line of the insufficient upper lip.

of the lower lip, require plastic operations for their relief (Fig. 100). Frequently these cases present a mass of cicatricial tissue which needs to be removed for the cosmetic effect.

Operation.—Here, as in other forms of plastic surgery, several steps are necessary to accomplish the end desired. First among these is the preparation of the patient for operation and a thorough understanding of his

FIG. 103.

FIG. 104.

FIG. 103.—Flap from lower lip placed in upper lip. Flap still attached to lower lip.
FIG. 104.—The graft from the lower lip has been united in its new position in upper lip. The mouth is too small.

physical condition. A study of the parts impresses the surgeon with the unequal size of the two lips. It will readily be seen that if the tissue

FIGS. 105 and 106.—Mouth made larger by incising the angles.

in the two were equalized, the patient's mouth would be in an approximately normal condition. With this end in view, I utilize the superabundant tissue of the lower lip and add it to the insufficient upper lip

to relieve the tense and contracted condition. When I first transferred a section of the lower lip to the incomplete upper lip, in 1905, I believed I was the first surgeon to perform this operation, but I have recently learned

Fig. 107.—Profile view before operation.

Fig. 108.—Profile view after operation.

that Dr. Abbe did this operation in 1898. To remove from the lower lip a portion of the tissue and add it to the upper lip corrects the deformity. Careful measurement of the two lips enables the surgeon to decide how

Fig. 109.—Front view before operation.

Fig. 110.—Front view after operation.

much tissue it is necessary to take from the lower lip and add to the upper in order to make the two equal.

First Step.—Division of the upper lip, by making incision through its thickness in the median line, is the first step to take (Fig. 101) following

which, after hemorrhage is controlled, an incision is made in the lower lip so as to secure a V-shaped flap to be inserted in the upper lip (Fig. 102). Beginning at the left of the center, carry the incision obliquely downward

FIG. 111.

FIG. 112.

FIG. 113.

FIG. 114.

FIGS. 111 to 114.—Cleft lip and palate in patient thirty-five years of age. He had been operated at one and seven years of age. Operated a third time, by the author, with the result shown.

to the median line of the lower lip, then upward toward a point corresponding to the place of beginning. This upward incision should not be carried more than half-way from the apex of the V to the mucous membrane of the

lip. This liberal attachment will secure good circulation for the flap. After hemorrhage has been controlled, this piece may be inverted, *i.e.*, the apex may reach up into the split upper lip and be secured there by sutures (Fig. 103). Strong silk sutures are passed through the mucous membrane, embracing a great part of the muscular tissue of the *right* side of the lower lip, and carried into the upper lip. Thus the lips are closely and firmly sewed to each other. The object of this is to prevent separation of the lips and the possibility of preventing union of the flap in its new position. The sutures must not be carried through the flap so as to interfere with the circulation. These stitches are temporary only, to be used until union of the flap from the lower lip to the upper has become thoroughly established.

B *A*

Fig. 115.—Photograph of plaster model of patient shown in Figs. 111 to 114. *A*, Before operation; *B*, after operation.

The freshened surfaces of the right side of the lower lip may be closed over by suturing the mucous membrane to the skin. This protects them from exposure and the formation of granulations. With the parts in position, the patient's under jaw may be immobilized by applying Barton's bandage. A substantial union of the flap with the right side of the upper lip should be accomplished in about three weeks when good circulation shall have been established. There is sufficient room between the lips at the left corner of the mouth to feed the patient by means of a tube.

Second Step.—The next step is to complete the upward incision of the right side of the lower lip and release the flap from its attachment. Then swing it over to the left side where the membrane and skin have been brought in contact, separate the skin from the mucous membrane, scarify the surfaces so as to leave them freshened and suture the flap into place, being

careful to have mucous membrane meet mucous membrane and skin meet skin. This done, attention should be given promptly to the lower lip by freshening the edges of the wound and suturing them.

FIG. 116.—The premaxillæ extend to the end of the nose.

FIG. 117.—Same case after operation. Six months old.

FIG. 118.

FIG. 119.

FIGS. 118 and 119.—Deep notch in the lip, before and after operation.

Secondary Operations.—After union has occurred, the two lips will be of about equal length and thickness. If the premaxillæ have been excised, the upper lip will still recede for the deformity cannot be wholly

overcome; but with the adjustment of artificial teeth (a bridge or plate) the lip may be made more prominent so that the deformity is less conspicuous. Care should be taken that the under side of the lip is sutured so that mucous membrane will meet only mucous membrane. It is better to have

FIG. 120.—Infant three months old, with complete double cleft lip.

FIG. 121.—Same patient at eighteen months of age.

the freshened surfaces under the lip closed. This may always be done by covering them with the mucosa. After the parts are united, sufficient time should be allowed for them to become fixed in their new position, with a good circulation established, when other steps called for may be

FIG. 122.—Cleft lip and palate in infant. An incisor tooth is attached to a pedicle of mucous membrane quite independent of bone (left side of patient).

FIG. 123.—Same patient one year later.

taken. These may include the removal of scar tissue, adjustment of the alæ of the nose, if required and, still later, the study of the mouth, which, following the operation, is sometimes too small (Fig. 104). To increase its size, incisions should be made at each angle of the mouth, carried backward, and the mucous membrane and skin approximated (Figs. 104 to

110). Time should be allowed for union to take place and a few weeks later the patient should return for any other operation that may be called for to improve the parts.

POST-OPERATIVE TREATMENT

The post-operative treatment of cleft lip, which has been looked upon in the past with so much uncertainty as to securing a good result, I regard, with the present facilities for retention, quite reliable. With horse-hair sutures only, with no pins, wires, buttons, adhesive straps across the lip, or other cumbersome and unnecessary appliances, we may expect to secure a smooth, well-formed lip, free from notches and scars. In single cleft lip operations, the nostril should nearly, or quite, conform in size and shape to the normal one; in double cleft lip, the two nostrils may be so constructed that they will be exactly alike.

Before the patient has recovered from the anesthetic, the retention bow is adjusted with the greatest comfort possible to attain in the management of such cases, and it will hold the tissues together until union may take place. Over the line of stitches, the surface is moistened with concentrated compound tincture of benzoin. Should mucus escape from the nose in considerable quantity, sufficient to cover the newly approximated parts continuously, the nose may be plugged with iodoform gauze and the secretions thus prevented from escaping. The gauze is tightly rolled and saturated with compound tincture of benzoin. The surface of the lip should be kept absolutely clean, dry and free from secretions and incrustations, which may be accomplished by carrying an applicator saturated with boric acid solution over all the stitches, thus removing all secretions and moisture. The under surface of the lip should be irrigated afterward, the surfaces dried as well as can be by the use of applicators, and touched over with a twenty per cent. solution of argyrol as a prophylactic measure.

Infections of the lip should not occur. It is presumed that, prior to the operation, the surface of the lip has been made as nearly antiseptically clean as possible. If so, and the parts are kept clean following the operation, infection is not at all likely to occur. Should infection take place, the parts must be thoroughly flushed, dried and saturated with a twenty per cent. solution of argyrol. If the infection does not clear up promptly, pure tincture of iodin should be used. I have found the ultra-violet ray most efficient in controlling infection of the skin and as a prophylactic. In operations about the mouth and face, I believe the proper use of the actinic ray most valuable in arresting infection. The danger of the child handling and interfering with the lip is overcome completely by constructing the author's long pasteboard cuffs illustrated in Fig. 124, which extend from the hand to a point midway between the elbow and the shoulder. With these

constructed of proper size, the child has unlimited motion of the shoulder, hand and fingers, but it is impossible for him by reason of the restricted elbow, to bring his hand to his mouth. The cuffs fit the wrist snugly so they cannot slip over the hand. The ophthalmologist finds them of equal value in keeping the fingers from the eyes.

FIG. 124.—Showing the author's cuffs properly placed. This child was operated for single cleft lip and palate.

Author's Cases.—In the presentation of the following pictures of patients operated by the author, it is not desired to criticize my fellow practitioners, but it is impossible to refrain from making an earnest appeal for an improvement in training so that in time these deformities may be better understood and more successfully treated. In conversation with teachers in our foremost medical colleges, we learn that little or no consideration is given to oral surgery, so far as it relates to congenital defects and conservatism in performing operations within the mouth. Much less attention, if possible, is paid to the great, broad field of dental pathology with its many general maladies of dental origin.

The object of presenting this group of pictures is to show the psychological effect produced by the removal of a conspicuous deformity. This young girl (Fig. 125) had a broad and complete cleft of the palate; her

FIG. 125.—Speculum in place, giving view of broad cleft in palate.

nostrils, following an operation with unsatisfactory result, were broad and her nose flattened; a notch, left in the lip after operation, rendered her teeth constantly visible, showing even the gum margin.

FIG. 126.—Front view before operation.

FIG. 127.—Front view after operation.

Three steps were necessary in her case to produce a condition closely approaching normality. First, to operate upon the cleft of the palate; second, to operate upon the nostrils and flattened nose, bringing them

into normal form; and finally, to operate to overcome the deformity of the lip. The operations are clearly outlined in the accompanying photographs.

It will be seen that the flattened nose has been raised to its proper position and the nostrils brought to their normal form. The deep notch in the lip has been removed and the lip is perfect. Horse-hair sutures, which are used in these cases, have left no marks. Skin has been approximated with skin and mucous membrane with mucous membrane. From the ugly notch which was presented, a typical Cupid's Bow has been produced and the central portion of the lip has been made pendant, as it should be

FIG. 128.—Profile before operation.

FIG. 129.—After operation. Lip and nostril corrected.

Observe the calm, placid profile of the girl after the operation, in comparison with that before operation. The face in the photograph before operation is one stamped with despondency and depression. Such people do not seek society, but rather go into seclusion. The front view picture before operation seems to express the depth of sorrow, while the one made afterward depicts the highest degree of buoyancy. From my acquaintance with this girl I am satisfied that her whole life was changed. She seemed to have entered into a new and delightful existence.

Figs. 130 to 133 show efforts made by another surgeon to correct double cleft lip without first properly adjusting the premaxillæ. The prominence of the bones over which the cleft lip was united causes an extreme protrusion which strongly resembles the lip of a monkey, while the deformity of the palate was unsuccessfully operated.

Fig. 130.

Fig. 131.

Fig. 130.—This child had protruding premaxillæ. An effort was made to close the lip over them, with the result illustrated. The boy could not close the lips except with the greatest difficulty. His mouth was constantly open. The deformity following operation was nearly as great as the one which the surgeon undertook to correct.

Fig. 131.—Profile of same child, showing the extreme prominence of the lip, due to a misconception of the proper treatment of the protruding premaxillæ. The surgeon did not realize that the protruding premaxillæ called for bone surgery, which should always be the first step in correcting the deformity.

Fig. 132.

Fig. 133.

Fig. 132.—The protruding premaxillæ in this child were moved back into their correct position by making an oblique incision through the vomer. The edges were freshened, as well as the edges of the maxillæ. Two strong wires were carried through the maxillæ, and anterior to the premaxillæ under the soft parts and close to the bone. These bones were firmly immobilized. The soft parts over the freshened surfaces of the bones were sutured with horse hair. Fifteen months later, the imperfections of the lip were removed, the vermilion border corrected and the dilated nostrils were normal. From the ugly appearance that he presented in Fig. 130 we have in Fig. 132 a handsome boy.

Fig. 133.—Here we have a profile showing the great improvement made in this lad by moving the bones into proper position and correcting the lip.

Figs. 130 and 131 show the child as presented, Figs. 132 and 133, after operation. The bone was carried back, its edges freshened and wired firmly in its normal position before the correction of the lip was attempted.[1]

FIG. 134.—Front view, as patient applied for operation. Premaxillæ amputated by another surgeon, together with greater portion of columna of nose.

FIG. 135.—Result on palate and nose after operation.

FIG. 136.—Profile before operation.

FIG. 137.—Profile after all operative work was finished.

In the above series of photographs, I present first (Fig. 134) a young man whose face is evidence of erroneous surgical judgment in treating

[1] From Minnesota Medicine, May, 1921.

congenital defects of the mouth. Congenital cleft palate with protruding premaxillæ was his abnormality. The first attempt to overcome this defect proved to be a serious error. The premaxillæ which no doubt protruded were amputated. The columna of the nose and a portion of the vomer were removed (Fig. 134). The lip, consequently, receded abnormally and remained as a tightened band from angle to angle of the mouth. The palate was operated, with results as shown in Fig. 134. Subsequently, the only hope of adding tissue to the upper lip in order to give it proper length from angle to angle and to relieve the tension was lost by the complete excision of a large V-shaped section of the lower lip.

This young man's experience is similar to the experience of many whose operations have been performed by men without modern training in this particular field of surgery. The loss of the premaxillæ and the incisors which they contain, leads to a gradual and certain protrusion of the mandible as well as retrusion and contraction of the maxillæ. It is natural for the upper incisor teeth to lap over the lower ones, thus holding the lower jaw back in its normal position.

The treatment employed with a view to correcting, as far as possible, the serious deformity in this case was to first close the cleft palate. This was accomplished by utilizing the palato-pharyngei muscles to replace the tissue which was lost following previous operations. The muscles were utilized to add an inch and one quarter to the length of the palate with good result. The next step was to make use of the tissue forming the lower portion of the nostril on each side, bringing it together to form a columna. After this, flaps were taken from the muscles of the cheeks within the mouth to fill the large opening left between the nose and the mouth. The next step was to have a bridge constructed, with incisor teeth. This bridge assisted in forcing the upper lip forward and in a great measure relieved the deformity, giving the face a proper contour. Having done this much, the next step was to widen the mouth by making incisions at the angles.

Another Case.—This child had undergone nine operations before he came into my hands. There was little left of the palate; the premaxillæ had been removed; the nose had been greatly flattened and the nostrils widely dilated; the lower lip extensively protruded, and the upper lip was very short.

The first step taken was to construct a good palate, utilizing the pharyngeal muscles and making a palate long enough to close the post-nasal opening. Having succeeded in getting a good palate, we then operated upon the nose so as to elevate it to normal position, at the same time correcting the flattened nostrils (Fig. 139).

Three months later, we transferred a V-shaped piece of tissue from the redundant lower lip into the upper lip, dividing the upper lip in the median line so as to receive the section of the lower lip (Figs. 140–142).

FIG. 138.

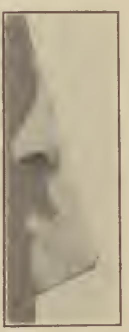

FIG. 139.

FIG. 140.

FIG. 141.

FIG. 138.—Profile as presented.
FIG. 139.—Nose elevated to normal and flattened nostrils corrected.
FIG. 140.—Lines of incision in transferring a section of the lower to the upper lip.
FIG. 141.—Profile view from the left side showing the transposed flap of lower lip into the upper.

FIG. 142.

FIG. 143.

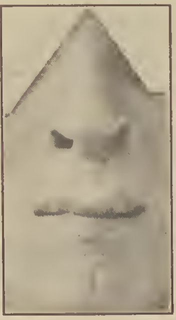

FIG. 144.

FIG. 145.

FIG. 142.—Shows the anterior view of transferred section of lower lip into upper.
FIG. 143.—Shows clearly the section of the lower lip which has been transferred into the upper. The lines of membrane are irregular.
FIG. 144.—Shows the lines of membrane and skin corrected so that the lip is normal.
FIG. 145.—Profile of the newly constructed lips and nose.

FIG. 146.—Congenital double cleft lip, protruding premaxillæ. Maxillæ and soft palate normal.

FIG. 147.—Profile same patient showing protrusion of premaxillæ and lip. Prolabium is seen to extend considerably beyond the end of the nose.

FIG. 148.

FIG. 149.

FIG. 148.—Intra-oral aspect of the protruding premaxillæ. The palate was not cleft. This shows the surfaces of the premaxillæ with which union was desired.

FIG. 149.—Result after three months. The premaxillæ were perfectly united and solidified with the maxillæ, and the cleft in the lip was closed. An incisor tooth is erupted from the newly united premaxillæ.

FIG. 150.—Profile of same patient showing lip closed. The nose, as is usual in such cases, is drawn backward when the premaxillæ are moved into correct position.

FIG. 151.—Profile showing deformity of the nose corrected by lifting it and at the same time narrowing the broadened nostrils.

FIG 152.—Front view after premaxillæ, lip and nose were made normal.

FIG. 153.—Front view of patient with a probe in hole in median line of upper lip which had previously been operated. There is a complete cleft of hard and soft palates.

FIG. 154.—Same after operation.

FIG. 155.—Profile of same patient before operation.

FIG. 156.—After operation.

In the early summer of 1919 a boy four years of age was brought to me by his mother with a view to having something done to remove the distressing deformity with which he was afflicted. The photographs of this lad

FIG. 157.—Deep sinuses extending into the lips marked by toothpicks. They extend three-quarters of an inch into the tissues. These sinuses correspond to the position of the separated part in double cleft lip.

FIG. 158.—Extensive protrusion of premaxillæ, double cleft lip and cleft of entire palate.[1]

FIG. 159.—Interior of mouth showing protrusion of bones, double cleft lip and palate. A pulpless, loose tooth is visible. This was removed before the first operation.[1]

[1] From Minnesota Medicine, May, 1921.

prior to, during and subsequent to all his operations, I herewith append. He lived in a far Western town. He possessed a brilliancy of mind of rare quality. The operations which I designed for him, some critics have

Fig. 160.

Fig. 161.

Fig. 160.—Premaxillæ brought into correct position with the maxillæ, the edges freshened and perfectly immobilized. The bones are united and we have a consolidated well formed bony arch. Cleft of soft palate closed with excellent result.[1]

Fig. 161.—Front view showing double cleft lip and broadly flattened nose, the breadth being greater than the length. Operation on bones and palate completed and patient ready for lip operation.[1]

Fig. 162.—Profile of boy after the premaxillæ were united to the maxillæ.[1]

Fig. 163.—Flattened nose lifted, after the lip was closed.[1]

[1] From Minnesota Medicine, May, 1921.

declared not only hazardous but impossible. I have previously written denouncing the excising of the premaxillæ as a procedure which cannot be regarded in any other light than that of a tragedy. Such would be the case had the premaxillæ been excised in this patient.

Fortunate it is that the maxillæ and soft parts are richly supplied with blood vessels and nerves. This fact largely contributes to our successes following operations on these parts.

To restore this boy to normality required several operations. The first moved the premaxillæ into position, by the method described on page

Fig. 164.—Front view before operation.[1]

Fig. 165.—Construction of palate, lip and nose completed. It will be seen that the nose in Fig. 161 is nearly twice as broad as in Fig. 165.[1]

179. The twisted wire can be seen in Fig. 160. A good bony arch was established. Six weeks later, the palate was closed with an excellent result as illustrated. Figure 161 shows the condition of the lip and nose following these two operations. Figure 162 is a profile view at the same stage. The next step was to close the lip, according to the method described on page 34. This operation took place six weeks later. Figure 163 shows a profile of the boy after the nose was elevated. This operation was performed two months after the lip was closed. Figure 165 is a front view after the palate and broad, flattened nose and lip were made normal.

[1] From Minnesota Medicine, May, 1921.

CLEFT LIP OPERATIONS

Age	Operations up to 1915 Number	Operations up to 1915 Deaths	Operations from 1915 to 1921 inclusive Number	Operations from 1915 to 1921 inclusive Deaths
1 month	94	24	52	9
2 months	127	21	71	5
3 months	146	12	85	7
4 months	154	5	95	5
5 months	103	7	48	0
6 months	70	0	27	3
7 to 12 months	104	3	61	2
1 year	148	3	98	1
2 years	79	6	60	2
3 years	45	1	42	0
4 years	63	1	43	0
5 years	60	4	26	0
6 years	29	0	28	1
7 years	37	0	12	0
8 years	27	0	14	0
9 years	29	0	13	0
10 years	26	0	15	0
11 to 15 years	83	1	51	0
16 to 20 years	101	0	48	0
21 to 25 years	59	0	44	0
26 to 30 years	60	1	43	0
Over 30 years	5	0	51	0
	1649	90	1027	35
	1027	35		
Total	2676	125		

Percentage Table

	All cases	1915 to 1921 inclusive
Percentage of deaths of all ages	4.67	3.40
Percentage of deaths under 1 year	8.33	7.06
Percentage of deaths from 1 to 2 years	1.62	1.02
Percentage of deaths from 2 to 4 years inclusive	3.01	1.37
Percentage of deaths from 5 to 10 years inclusive	1.58	0.92

The deaths noted have occurred while the patients were under my care. In all cases I have watched the patient until the lip has thoroughly healed. No effort has been made to trace patients after they left my hands. It will be noted that the mortality in cleft lip cases exceeds that

in cleft palate. With improved facilities and refinements in technic, together with a careful study of the physical condition of the patients and with due regard for preparation and post-operative care, the mortality rate has been materially reduced. The lip operation is made when the child is older and more susceptible to depression.

CONGENITAL FISSURES OF THE LOWER LIP

Sinus or Fistula in Lower Lip.—In Sir Arthur Keith's Monograph on Congenital Malformations of the Palate, Face and Neck appears the following: "A bilateral cleft in the upper lip is frequently associated with a curious malformation of the lower lip, in which two fistulæ or recesses open on the lower labial surface opposite the clefts in the upper lip. The orifice of each recess may be raised into a nipple-like process, which, when the mouth is shut, fits into the corresponding upper cleft. This was the condition in a specimen submitted to me by Mr. Woolcombe, which was excised from the lip of a boy, aged three months. The orifice of the recess was situated at the apex of the papilla; its fundus. about the size of a rice-grain, lay within the substance of the lip and was surrounded by mucous glands which opened into it. A layer of striated muscle surrounded the pocket, which, in nature, was clearly a localized invagination of the mucous membrane and glands of the lip. In three cases reported recently by Mr. R. C. Dunn, there was one in which the recesses opened on nipple-like processes; another in which the orifices were wide and flush with the surface of the lip; while in the third the two recesses were confluent, thus forming a transverse depression on the surface of the lower lip. The condition has been described by Mr. Bland-Sutton, Mr. Arbuthnot Lane, Mr. Clutton and Dr. Ballantyne. There is no example of this malformation in London museums. An appeal to comparative anatomy does not afford a satisfactory explanation. Seeing that the malformation is so closely associated with bilateral harelip and cleft palate, a condition which occurs normally in certain fishes, it is clearly in this vertebrate class that an explanation of the condition is to be sought. On each side of the middle line of the lower lip of sharks, exactly in the position where these recesses are found, open a group of mucous canals which are connected with nerve endings found in fishes. It is possible that these labial recesses have some relationship with these two mucous labial organs found in selachians, but the matter requires further investigation."

Author's Cases.—Twelve cases have come under my observation, presenting malformations of a nipple-like process developing on the lower lip, which corresponded in position to the clefts in the upper lip. In the first, that of a child three months old having unilateral cleft lip on the left side, a nipple-like prominence was present and when the lips were in proxi-

mity, it passed into the fissure of the upper lip. This prominence was made up of exceedingly hard, horny-like epithelium. It was excised at the time of the lip operation. The father had this defect, but no defect of the palate or upper lip (Fig. 166). The second case was that of a child five months old, with double cleft lip. There were two recesses in the lower lip, corresponding in position to the double cleft lip fissures. These recesses or pits were not unlike those we see in the lips of people whose upper teeth lap considerably over the lower teeth and make impressions of some depth in the surface of the lower lip. In this case I found that the father, whose upper lip was normal, had similar pits in the lower lip. He informed me that his father had the same kind of pits in the lower lip, though the upper lip

FIG. 166.

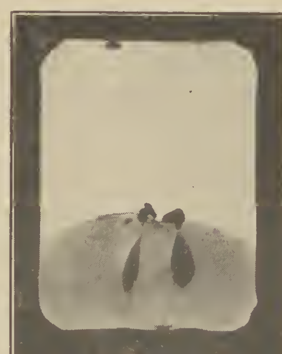

FIG. 167.

FIG. 166.—Two fistulæ in the lower lip extending to a depth of three-fourths of an inch. Large mucous glands were found at the base.

FIG. 167.—Radiogram showing ducts given off from large mucous glands deeply situated in the lower lip. These ducts and glands were injected with bismuth paste before the x-ray picture was taken. In the placing of the film, the radiographer accidentally displaced considerable of the bismuth paste. The glands are not dilated, therefore, to the extent they might have been. A picture similar to this, the author believes, has not heretofore appeared in the literature of the subject.

was normal. The third case, that of a child four months old, with double cleft lip, showed two nipple-like processes extending upward from the lower lip corresponding to the positions of the fissures in the upper lip. These processes were hard, wart-like in structure, two lines in length and conical in form. The mother of this patient had one horn-like projection on the lower lip, though the upper lip and palate were normal. The fourth was a woman twenty-three years old (Fig. 157). The large ducts extended about 2 cm. into the central part of the lower lip. Wooden tooth picks

stained with iodin were placed in the ducts to indicate their locations clearly. Another case which came under my notice was a man 24 years of age who had a double cleft lip and two sinuses extending from two enormous glands three quarters of an inch in depth. See Fig. 167. I cannot account for these malformations except on the ground of heredity. There is a striking similarity in these conditions.

MEDIAN CLEFT IN LOWER LIP

In Professor Keith's work, speaking of median cleft in the lower lip and mandible, he states: "Among the 250 specimens of malformation examined, only four showed this condition: a full-time child in the museum at St. George's Hospital and three specimens in the museum of this college, one from an ass, another from a cockatoo and a third from a sparrow." Only one child in this great collection has this defect (Fig. 170). Professor Keith further says: "Seeing that the lower lip and mandible arise by the fusion of the right and left halves, their immunity from median fissure, as compared with the upper lip and palate, is surprising. In four other specimens there was an apparent cleft of the lower jaw, but, when the condition was more minutely examined, it was seen that the lesion was really the result of a bifurcation or doubling of the buccal cavity, an attempt at the formation of twins."

FIG. 168.—Median cleft in lower lip before operation. (*Courtesy of Rev. F. C. Aldrich, of Aligarth, India.*)

FIG. 169.—Same patient two weeks after operation. Operated on by Dr. J. Fletcher Robinson.

In answer to Professor Keith's query, it may be stated that when we study the relation of the upper jaw to the lower (Fig. 213) it is easy to understand why the fusion of the right and left halves of the mandible

takes place and why the bones and lip unite. In being brought upward by the traction of the muscles of mastication, the two halves of the mandible strike on the inclined planes of the maxillæ, and, while crowding them apart, the halves of the mandible are crowded together, thus securing union of the parts. This is further evidence of the result of pressure of the mandible against the palatal plates of the maxillæ. See pages 100 and 101.

Figs. 168 and 169, showing an Indian baby, were sent me by Rev. F. C. Aldrich of Aligarth, India. They exhibit a median cleft of the

Fig. 170.—"No. 244.05 (Teratological Series): Median mandibular cleft. Cast of the head of a girl aged 4 months showing a median congenital cleft of the lower lip. The condition was not inherited. The child died during an attack of broncho-pneumonia. Presented by Prof. A. MacCormick, 1912." (*From the Museum of the Royal College of Surgeons, London.*)

lower lip before and after operation. These pictures are of special interest since the deformity occurs so rarely. This patient was operated upon in India by Dr. J. Fletcher Robinson, formerly of the Mayo clinic, now Civil Surgeon in Aligarth District. A deformity of this kind has never come under my observation.

Figs. 170 and 171 were given me by Sir Arthur Keith in October, 1921, as examples of a median cleft in the mandible and the lower lip. The legend for Fig. 170 is his own.

FIG. 171.—Picture of an eagle with cleft in the lower beak—(*From the Museum of the Royal College of Surgeons, London.*)

TABLE OF DEFORMITIES OF MUSEUM SPECIMENS
By
PROF. KEITH

	A	B	C	Total
Recesses and papillæ on the lower lip				
Median clefts on the lower lip and mandible	......	1	3	4
Naso-maxillary cleft	......	4	......	4
Lateral nasal cleft	3	1	......	4
Mesial nasal clefts	......	......	5	5
Lateral nasal proboscis				
Recess on nasal septum				
Congenital perforation of nasal septum	1	......	......	1
Occlusion of anterior nares	2	......	......	2
Occlusion of posterior nares				

(A) Human specimens in the Museum of the Royal College of Surgeons in England.

(B) Human specimens in the museums of the metropolitan medical schools.

(C) Specimens of vertebrate animals, other than man, chiefly in the Museum of the Royal College of Surgeons.

The flexibility of the tissues of the face, especially of the lips, and the possibilities of molding them into any form the surgeon may desire to pro-

FIG. 172.—Illustrates congenital fissures extending from the angle of the mouth backward to the occiput. (*Royal College of Surgeons.*)

FIG. 173.—Women of Sara-Kabba, Africa who have worn wooden discs to produce the lips shown. This is the height of fashion with these people. (*Dr. Kumm.*)

duce, are illustrated in the two portraits which I present here. They are taken from the work of the scientist and African explorer, Dr. H. Karl W.

Kumm. At the left is a Sara-Kabba lady with the beak face, the spoon bill type; at the right, another lady of the same tribe is shown with a plate lip (Fig. 173). This lower lip is the extreme of elegance in the Dark Continent.

The form of the lip in these two women results from the introduction of plates or bows of wood into the mouth in such a way as to exert continuous pressure upon the parts until they have the appearance here illustrated. There are two distinct ideas of beauty among these people. One is to shape the lips so that they resemble the beaks of birds; the other is known as the plate mouth. The lips of the women resemble large sized saucers. The disks worn to bring about this effect are three inches in diameter for the upper lip and six inches for the lower.

CHAPTER II

CLEFT PALATE

Congenital fissures of the palate, accompanied by cleft lip, are so conspicuous, of such frequent occurrence and their influence upon the patient so depressing, that measures looking toward their successful treatment have always been regarded by surgeons with deep interest. Cleft lip, with cleft palate, no doubt is one of the most distressing deformities which befalls mankind. The unfortunate sufferer, conscious of his deformity and his inability to speak distinctly enough to be understood by his associates, too frequently isolates himself and shuns the society of his fellow men.

Palatal defects may be congenital or acquired. Cleft palate, including the velum, uvula, hard palate and alveolar process, with cleft lip either single or double, invariably is congenital. Defects of the palate resulting from trauma or disease are less frequent.

Definition.—The definition generally given for cleft palate is: "A congenital deformity, characterized by a fissure or fissures of the palate due to arrested development." From the foregoing, we find the opinions expressed are that congenital cleft palate is the result of incomplete development of the tissues necessary to enter into its normal formation. The opinions of authors thus expressed have been based, no doubt, on their observation of the open space between the oral and nasal cavities. The error might easily be accounted for since the open space suggests an absence of tissue. The deformity, the statements of many authors to the contrary notwithstanding, is *not* the result of *congenital deficiencies* of the parts in question, nor *arrested growth of the palate. All children who have congenital cleft palate, with rare exceptions, have in the palate at birth* the normal amount of tissue. The palatal plates, however, are misplaced upwards and ununited in the middle line. The palate *is cleft*. Later in life the tissues may atrophy for want of use. Therefore, a cleft palate is a fissure, a non-union of well developed parts, not, with rare exceptions, the result of arrested development nor failure of a normal quantity of tissue to enter into its structure.

Embryology.—In the human embryo of about the third week, the face is in the process of development. From the front of the cephalic mass, five tubercles bud out, of which the first, the premaxillary, passes vertically downward (Figs. 174 and 175). This tubercle is double and forms the

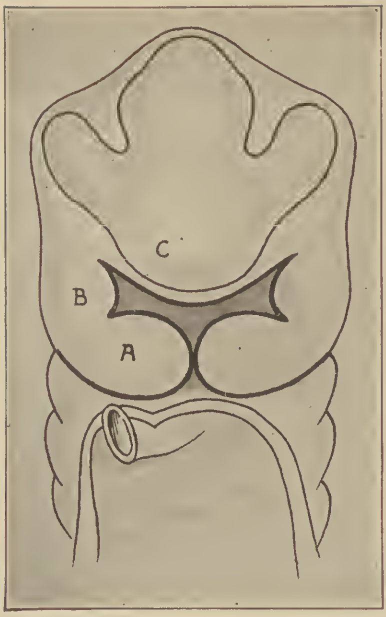

FIG. 174.—Head of fetus at end of fifth week. *C*, Frontal nasal process; *B*, maxillary process; *A*, mandibular processes. (*His.*)

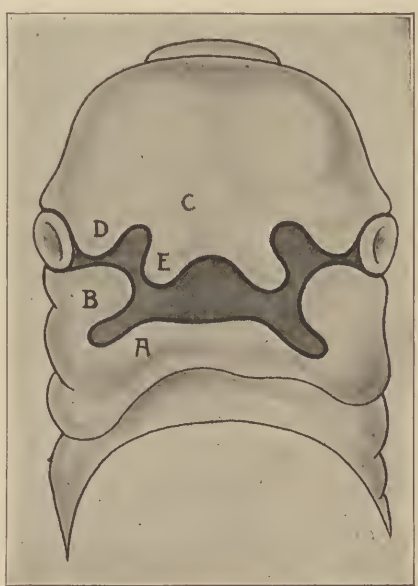

FIG. 175.—Head of fetus in the seventh week. *A*, The now united mandibular processes; *B*, the maxillary process; *C*, fronto-nasal process; *D*, lateral nasal process; *E*, globular processes attached to the nasal part of the fronto-nasal process. The central nasal processes are separated from the lateral on each side by the lateral nasal groove which represent the anterior nares. (*After His.*)

premaxillæ in which two and sometimes four incisor teeth are developed. It therefore bears the name 'incisor tubercle.' The rudimentary maxillæ, which are widely separated, are developed at each side of the incisor tubercle though not united with it; while the fourth and fifth

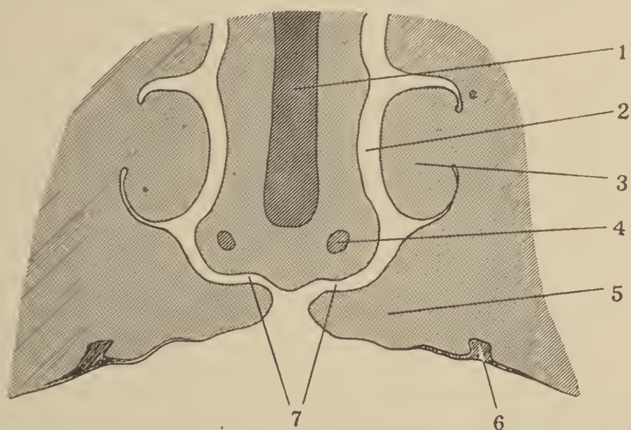

FIG. 176.—Eight centimeter embryo. 1. Nasal septum; 2, nasal cavity; 3, turbinal; 4, cartilage paraseptalis (*Jacobson*); 5, palatine process; 6, tooth rudiment; 7, connection of the nasal cavity with oral cavity. (*Warnekros.*)

tubercles, which are separated in front, subsequently unite in the median line and form the mandible. Simultaneously the palate begins to be formed by the approach toward the median line of the two horizontal

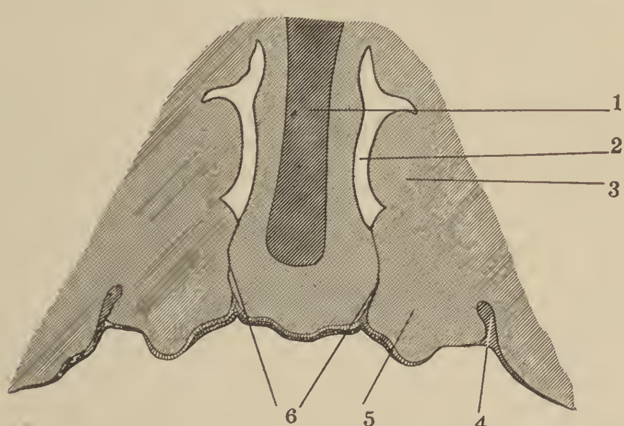

FIG. 177.—Eight-centimeter embryo. 1, Nasal septum; 2, nasal cavity; 3, turbinal; 4, tooth rudiment; 5, palatine process; 6, union of the palatine plate with the nasal septum (*Warnekros.*)

plates developing from the maxillary processes on either side. If the palatal processes of the maxillæ unite in the median line and blend also with the premaxillæ and the vomer grows downward to meet the palatal processes in the line of union, the upper jaw will be normal. If, however,

the superior maxillary and premaxillary processes are misplaced and fail to unite with each other, cleft lip and palate, in one of their many forms, will result (Fig. 247). By the beginning of the third month, the parts

FIG. 178.—View of roof of oral fossa of embryo, showing lip groove and the formation of the palate. *Lg*, Lip groove; *Pp*, palatal process. (*His.*)

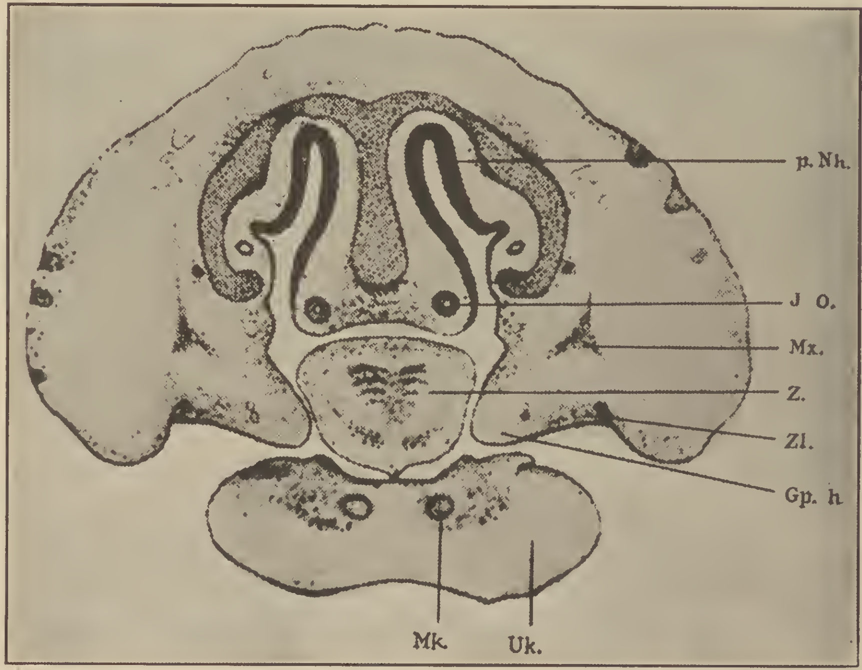

FIG. 179.—Frontal section through face of embryo of mole, showing position of tongue during development of the palate. *Mx*, Maxillary; *Z*, tongue, *Zl*, dental lamina; *Gp*, palatal process; *Mk*, Meckel's cartilage. *Uk*, mandible. (*Inouye.*)

which enter into the formation of the palate should be united (Figs. 176 and 177). The embryological development of the palate is beautifully and accurately illustrated by Prof. Inouye. Figs. 179 to 186 are from his work.

The mechanism by which cleft palate is formed is better understood by a study of the embryology of the enamel organ. I can do no better than to quote rather extensively from Bödecker.[1] He states on page 149, "Let us consider the direction taken by the epithelial cord of the *enamel-organ* into the depth of the connective tissue up to the time when the

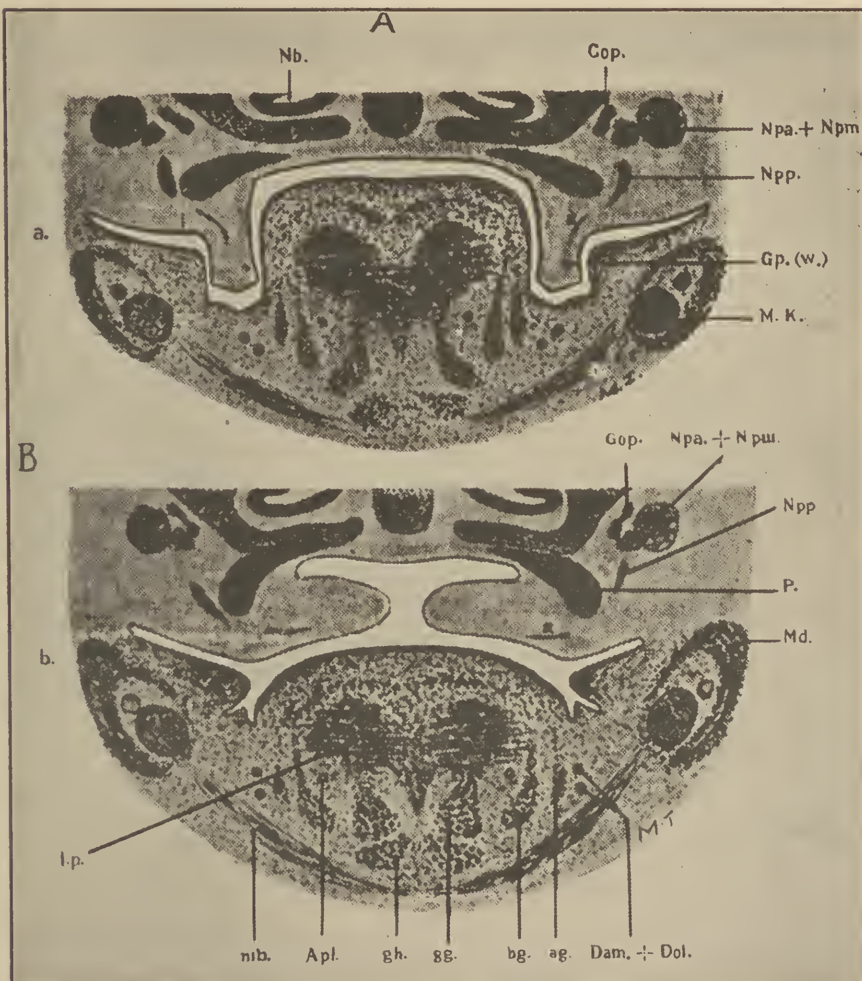

FIG. 180.—Frontal section through face of embryo, later stage than Fig. 179, showing change in position of palate processes and change in position and form of the tongue. (*Inouye.*)

enamel-organ is ready for the formation of the enamel. The first trace of the future tooth in the human embryo is visible about the sixth week of intra-uterine life, when the epithelium of the oral cavity is as yet little

[1] Anatomy and Pathology of the Teeth, 1894.

developed. Here we notice a furrow which is situated close behind the lip, and is succeeded by an elevation of medullary tissue (Fig. 189).

After this period follows the formation of an epithelial peg, appearing not at the bottom of the primitive dental furrow, but at some distance from the latter. This peg appears as a reduplication of the epithelial layer covering the elevation behind the furrow (Fig. 190).

Shortly afterward, the epithelial hill has gained in height considerably, and from the point which connects the hill with the rest of the oral epithe-

FIG. 181.—Sagittal section of embryo of mole, showing relation between the tongue and the skull. *Z*, tongue; *Uk*, mandible; *Hy*, hypophysis; *Bp*, basal plate; *Kd*, epiglottis; *Kk*, larynx. (*Inouye.*)

lium, the original peg has elongated into an epithelial cord. A striking feature of this cord is that from its periphery arise blunt or slightly-pointed offshoots while at the same time its distal end is noticeably broadened, the epithelia being arranged in radiating tracts throughout, but most markedly in the club-shaped enlargement of the distal end (Fig. 191).

In the third month of embryonal life, the *epithelial hill* still remains a prominent formation. From the point of its junction with the other epithelium arises the epithelial cord, which varies, to some extent, both

in width and in its course. Sometimes the cord runs nearly parallel with the base of the oral cavity, becoming devious on the way to its club-shaped distal end. Its periphery is slightly fluted, and from its lower contour arise scanty but strongly-marked epithelial offshoots, the significance of which is not perfectly plain. We may assume that a large secondary offshoot forms the epithelial cord of a future permanent tooth, but as to the significance of the short *secondary offshoot* we can only suggest that the epithelium primarily producing the cord at first assumed a direction which

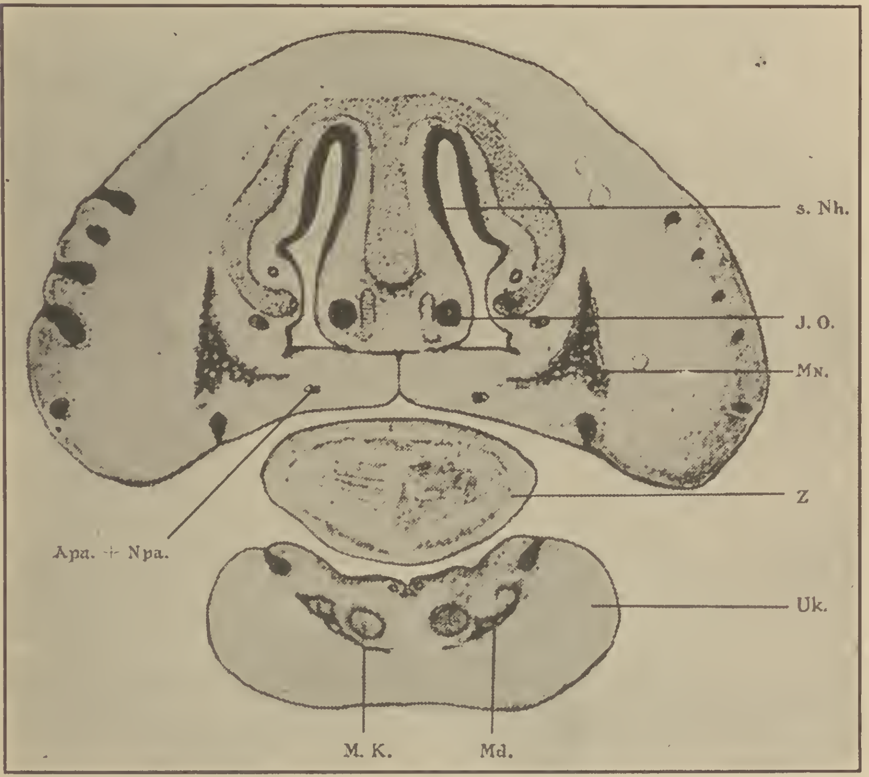

Fig. 182.—Frontal section through face of embryo, later stage than Fig. 181, showing union in median line of palatal processes. (*Inouye.*)

afterward was changed. This much is certain, that such short secondary offshoots perish and disappear in the course of further development. It would certainly be a bold hypothesis to consider all such short secondary offshoots as germs of supernumerary teeth, or of third dentitions. They are too common as compared with rare cases in which supernumerary teeth are found. At this stage of development the first trace of the papilla (the future dentin) is noticeable (Fig. 192).

Sometimes the epithelial cord is broad, exhibiting comparatively few blunt secondary offshoots. Its course is more or less vertical, into the depth of the connective tissue of the jaw. The epithelium within the cord is arranged into groups separated by trabeculæ somewhat resembling those of true myxomatous connective tissue. The club-shaped end of such a cord at this period shows a slight separation of the columnar epithelium

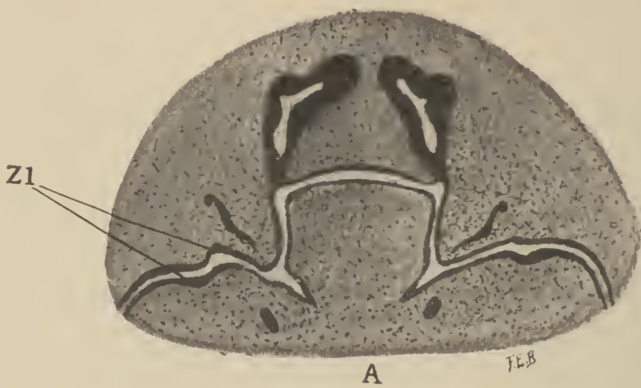

FIG. 183.

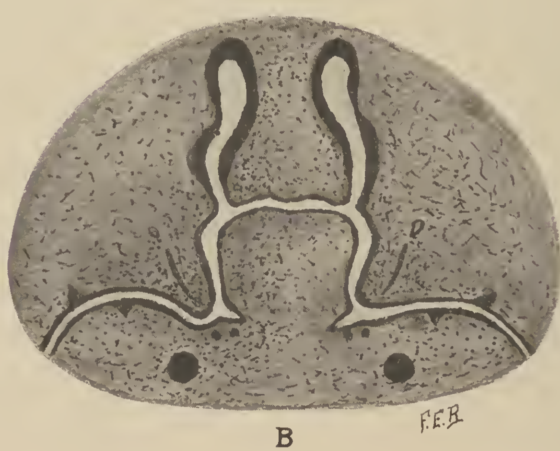

FIG. 184.

into an outer and an inner layer, whereas the center of the club-shaped enlargement is occupied by medullary corpuscles, which as yet do not exhibit the characters of a myxomatous reticulum. Unquestionably this medullary tissue has arisen from epithelia, which originally filled the club-shaped end of the cord, and it is this medullary tissue from which soon afterward, the myxomatous reticulum of the enamel organ proper originates (Fig. 193).

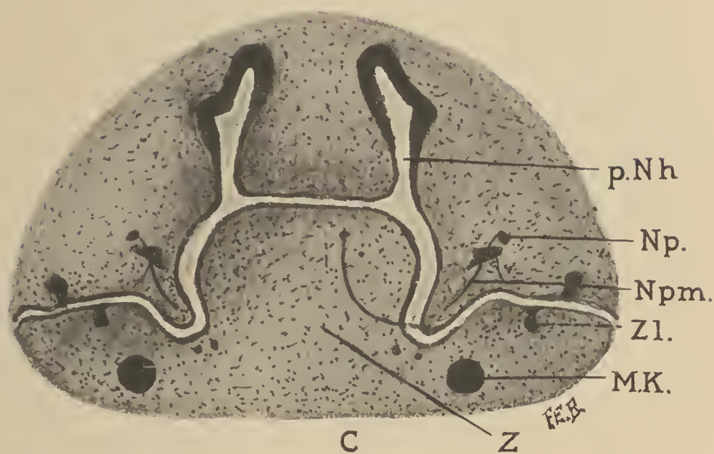

FIG. 185.

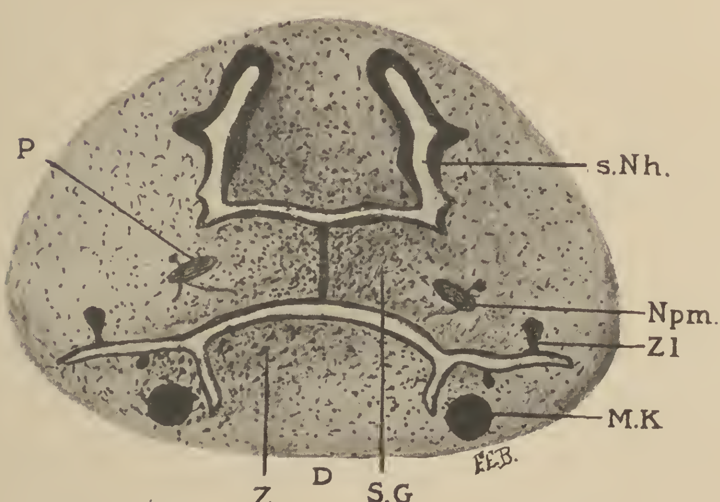

FIG. 186.

FIGS. 183 to 186.—Frontal sections through oral and nasal cavities, showing relative development of the palate and dental lamina. *Zl*, Dental lamina; *Z*, tongue; *SG*, palatal process; *MK.*, Meckel's Cartilage; *pNh.*, primitive nasal cavity; *s.Nh*, secondary nasal cavity. (*Inouye.*)

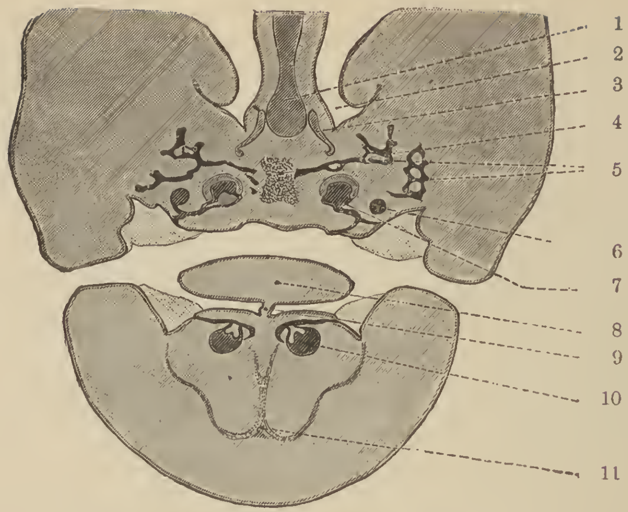

FIG. 187.—Embryo, 8 cm. Anat. Biol. Inste., Berlin, 160 G., 32 S., No. 5, last section. 1, Nasal septum; 2, nasal cavity; 3, cartilage paraseptalis (*Jacobson*); 4, Raphe of the palate; 5, intermaxillary bone (os præmaxillare); 6, rudiment of the lateral milk incisor; 7, rudiment of the central milk incisor; 8, tongue; 9, Fraenum of tongue; 10, rudiment of the mandibular central incisor; 11, raphe of the mandible. (*Warnekros.*)

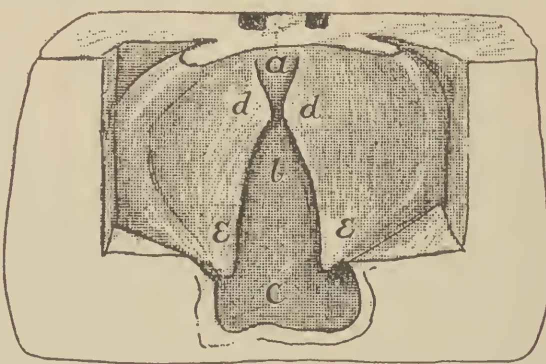

FIG. 188.—Model of the developing palate of a human fetus about six weeks old (28 mm. long) (*Anna Pölzl*). *a*, Premaxillary part of palate; *b*, septum of nose; *c*, naso-pharynx; *dd*, maxillary plates about to meet; *ee*, soft palate and uvula. (*Keith.*)

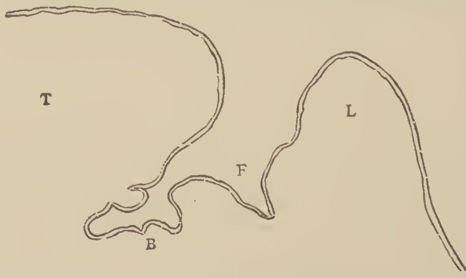

FIG. 189.—Human embryo six weeks old. Frontal section. *T*, Tongue; *L*, lip; *B*, base of oral cavity; *F*, furrow, in transverse section, funnel-shaped. Magnified 25 diameters. (*Bödecker.*)

When the embryo is at the age of four and a half months, the development of the enamel-organ has still further proceeded; its myxomatous

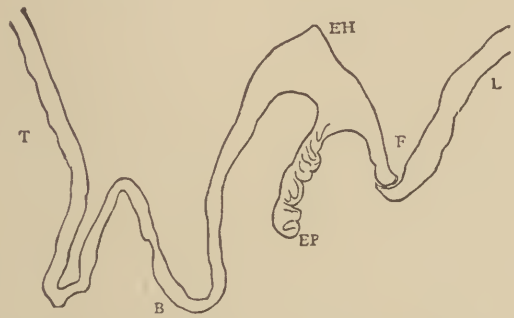

FIG. 190.—Base of oral cavity of human embryo two months old. Frontal section. *T*, Tongue; *L*, lip; *B*, base of oral cavity; *F*, furrow; *EH*, epithelial hill; *EP*, epithelial peg. Magnified 25 diameters. (*Bödecker.*)

FIG. 191.—Base of oral cavity of human embryo two and one-half months old, frontal section. *EH*, Epithelial hill; *O*, epithelial lining of base of oral cavity; *F*, furrow; *EC*, epithelial cord of enamel-organ; *EO*, club-shaped enlargement of the epithelial cord, the future enamel-organ. Magnified 25 diameters. (*Bödecker.*)

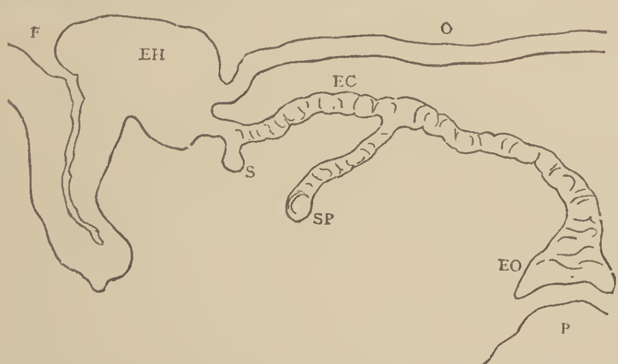

FIG. 192.—Base of oral cavity of a human embryo three months old. *EH*, Epithelial hill; *F*, furrow, sharply marked and lined by a heavy layer of flat epithelium; *O*, base of oral cavity; *EC*, epithelial cord; *EO*, club-shaped end of the epithelial cord, the future enamel-organ; *S*, secondary offshoot; *SP*, secondary offshoot, possibly a germ of the permanent tooth; *P*, papilla. Magnified 25 diameters. (*Bödecker.*)

tissue is plainly marked, and the papilla has correspondingly gained in bulk. The specimen illustrated is noteworthy for its short vertical epithe-

lial cord, which is directly in connection with the lining epithelium of the oral cavity. The secondary offshoots are but short, and not a trace of a

FIG. 193.—Floor of oral cavity of a human embryo three months old. *EH*, epithelial hill; *F*, furrow; *O*, oral epithelium; *EC*, epithelial cord; *S*, secondary offshoot; *EO*, medullary tissue of enamel-organ; *P*, papilla, detached. Magnified 25 diameters. (*Bödecker.*)

peg for the permanent tooth is visible in this section. The cup of the enamel-organ is lobulated, evidently belonging to a future molar (Fig. 194).

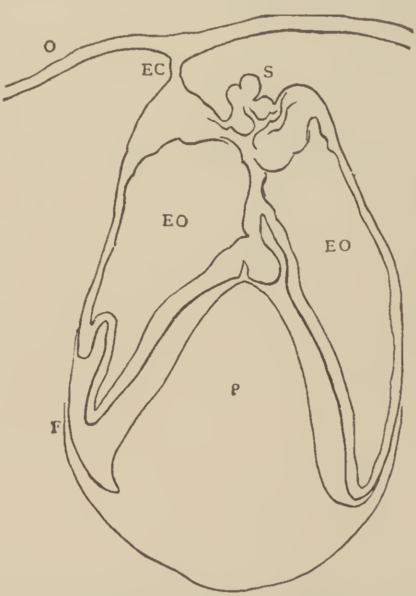

FIG. 194.—Enamel-organ and papilla of human embryo four and one-half months old. *O*, oral epithelium; *EC*, short epithelial cord; *S*, secondary offshoot; *EO*, enamel-organ; *P*, papilla; *F*, follicle. Magnified 25 diameters. (*Bödecker.*)

We now proceed to consider the changes in the enamel-organ about the beginning of the fifth month. If we examine the cup-shaped enlarge-

ment of the enamel-organ at this period, we observe a distinctly marked border composed of columnar epithelia, whereas the interior of the cup is filled with medullary corpuscles, which, in the center, present the so-

FIG. 195.—Epithelial cord terminating in the enamel-organ. Human embryo at the end of the fourth or the beginning of the fifth month of intra-uterine life. *O*, stratified epithelium of the oral cavity; *TT*, epithelial cord of temporary tooth; *PT*, epithelial cord of permanent tooth; *N*, epithelial nests and buds at the bottom of the furrow and along the cords of both the temporary and permanent teeth; *M*, myxomatous tissue of the enamel-organ (stellate reticulum); *EE*, external (outer) epithelium; *IE*, internal (inner) epithelium; *I*, intermediate layer between inner epithelium and myxomatous tissue; *P*, papilla with numerous blood-vessels; *E*, embryonal or medullary tissue crowded with medullary corpuscles at a certain distance from the epithelial formation. Magnified 500 diameters. (*Bödecker.*)

called stellate reticulum. At the end of the fourth and the beginning of the fifth month, we invariably find some epithelial cords, which, at their

anterior ends, are broadened and contain a distinctly marked stellate reticulum (Fig. 195).

Toward the end of the fourth month and the beginning of the fifth month, the stellate reticulum is composed of nucleated protoplasmic bodies, with a varying number of branching and interconnecting offshoots. With the low powers of the microscope the basis-substance in the meshes, inclosed by the corpuscles and their offshoots, appears to be homogeneous

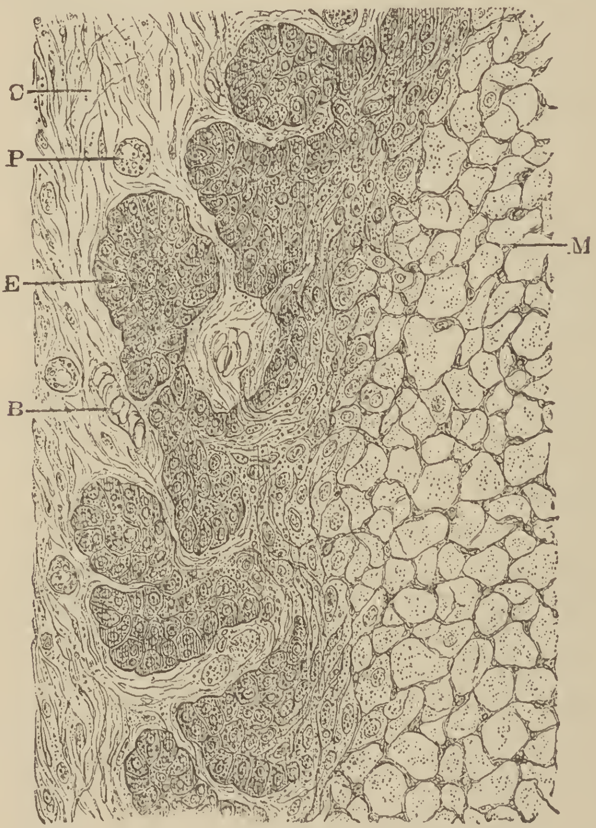

Fig. 196.—Budding of the external epithelium of the enamel-organ of a human fetus seven months old. *M*, myxomatous reticulum of the enamel-organ; *C*, delicate fibrous connective tissue; *E*, epithelial bud arisen from the external epithelium; *P*, large protoplasmic body filled with glistening coarse granules; *B*, newly formed blood-vessel. Magnified 500 diameters. (*Bödecker.*)

and structureless. The highest powers, however, reveal in this basis-substance the presence of a delicate reticular structure, even without the addition of any reagent. This structure has arisen by a direct transformation of the original medullary corpuscles into basis-substance. In the highest development of the stellate reticulum, such as seen in the seventh and eighth months of fetal life, the nucleated corpuscles are more slender,

and the reticulum is composed mainly of delicate branching and intercommunicating fibers.

The further changes of the external epithelium are of considerable interest. While about the fourth month of intra-uterine life the inner positions of the external epithelium are, as mentioned above, transformed into medullary tissue and participate in the formation of the myxomatous

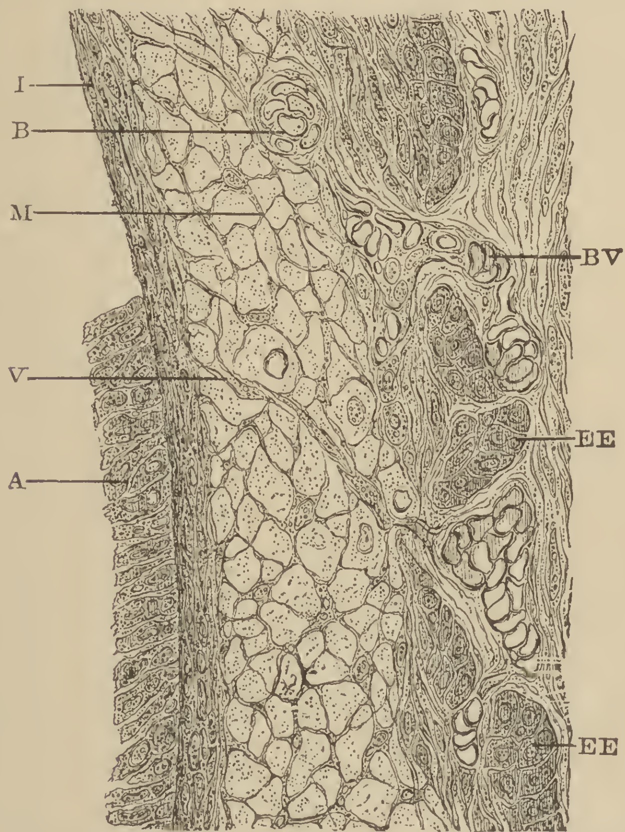

FIG. 197.—Isolated epithelial nests of the place of the enamel-organ corresponding to the neck of the future tooth of a human fetus seven months old. *M*, myxomatous reticulum of the enamel-organ; *A*, row of ameloblasts; *I*, intermediate layer composed of spindles and fibers; *B*, vesicle filled with hematoblasts and red blood-corpuscles; *V*, capillary blood-vessel forming from trabeculæ of the myxomatous reticulum; *B V*, irregular spaces filled with hematoblasts and red blood-corpuscles, lined by endothelia and in an incomplete connection with forming capillaries; *EE*, epithelial nests, the remnants of the external epithelium. Magnified 500 diameters. (*Bödecker.*)

enamel-organ, a single row of cuboidal epithelium is left. From the remains of this external epithelium, a new growth takes place of a markedly centrifugal character. By a multiplication of the epithelial elements, solid buds and knobs are formed, well known to previous observers (Fig. 196).

At the time when the buds sprout from the external epithelium, an active new formation of blood-vessels and blood-corpuscles takes place in the immediate vicinity of the buds. At first we notice large protoplasmic bodies with coarse granules, which were well known to Theodore Schwann, in 1839, by the name of blood-cells. With the increase of the size of these bodies, the granules likewise become coarser, and assume the properties of the so-called hematoblasts. These grow up to the size of red blood-corpuscles, and we not infrequently encounter in the bays between the buds, groups of hematoblasts or fully-developed blood-corpuscles, apparently isolated and in no connection with blood-vessels. At last, capillary blood-vessels arise from the conference of blood-cells which are filled with red corpuscles. The splitting of the external epithelium into isolated buds and nests of an epithelial character is especially marked near the neck of the future tooth (Fig. 197). At this place the amount of myxomatous enamel-organ in a seven-months' fetus is usually small, since a great quantity of it has already been transformed into enamel tissue. But even here a few small and isolated epithelial nests are seen, surrounded by a large number of capillary blood-vessels filled with blood-corpuscles. It is evident that all these blood-vessels are newly formed, and indeed we cannot trace the formation of blood-vessels in this situation step by step. Even the myxomatous trabeculæ of the enamel-organ participate in the formation of the capillary blood-vessels. We have seen closed spaces or vesicles, sprung from the basis-substance of the myxomatous tissue, filled with hematoblasts and red blood-corpuscles, partly in connection with already formed or forming capillaries. No doubt the living matter inclosed in the basis-substance has grown into hematoblasts. This process is indicated by the appearance either of coarsely granular or of compact glistening nuclei in the meshes of the myxomatous reticulum."

ETIOLOGY OF CLEFT PALATE

The literature on this subject is voluminous and largely conjectural. In reviewing it we find a great similarity in the opinions expressed. Heredity, prenatal impressions and imperfect nutrition during the early months of gestation are assigned as cause. Congenital cleft palate has a predisposing and an exciting cause.

Predisposing Causes.—The predisposing causes are heredity, the presence of supernumerary teeth, or, possibly, intervening mucosa which prevents the submucous tissue from uniting.[1] The factor of heredity is so well recognized that reference to it here might seem unnecessary. In many cases the physical characteristics of the parents, normal or abnormal, may be observed in their children. The shape of the head, nose, eyes

[1] Bödecker.

and other features often strongly resemble those of one parent. As in the cases below described, the parents may have normal palates while a grandparent, or even a great grandparent (and, no doubt, progenitors farther back of whose physical conditions the parents know nothing), having had the defect, transmitted it to grandchildren or to generations even farther away. It is thus that the law of atavism, or reversion to type, asserts itself. The statement parents often make that no ancestor ever had a cleft lip or palate applies usually only to their grandparents whom they have personally known. As to those farther back, as a rule, they know nothing.

Maternal Prenatal Impressions.—Maternal prenatal impressions are firmly believed in by many mothers, but proof that cleft palate has been due to such impressions has never been established. Regarding the cause of congenital cleft palate, Mr. Edmund Owen, in his Monograph on Cleft Palate and Harelip, dedicated to the author, states "It is improbable that maternal impressions have anything whatever to do with it. As a rule, the supposed fright comes long after the lips and features are developed. The lips are completely formed by the ninth week. Heredity has a powerful influence in many cases.[1]

The mother, who is inclined to ascribe the occurrence of cleft lip to some shock or fright received during her pregnancy, is generally somewhat late with regard to her explanation. At the very beginning of the third month of gestation (ninth week), the fissures about the orbit, nose and mouth have been effaced and the embryo, who, by the by, has only just made up its mind as to which sex it will join, is already beginning to assume, though as it were in a rough sketch, a definite facial expression. At a later period than this no maternal impression, however severe, could possibly have the least effect. What is done cannot be undone." It would seem that in the case of cleft palate, cleft lip, or any other congenital deformity in a twin, if prenatal impressions were a factor, both children should be similarly defective. The author has performed eighteen operations for cleft palate, with cleft lip, on twin children. In each case one child of the pair was normal. In the case of seven, the defective child was larger, weighed more and was the more robust at birth. In the practice of Dr. Shearer single cleft lip and cleft palate appeared in twin children. One child had cleft lip on the right side and the other on the left. I have little faith in the theory that prenatal impressions cause failure of union of the bones. In the greater number of cases, in which this cause has been given, it has been found that the mental shock occurred subsequent to the fifth month when, if physiological processes were not interfered with, union of the bones would be complete. It is too apparent

[1] See Chapter on Eugenics.

to require argument that a mental impression could not separate a suture. Defective nutrition or general debility of the mother during the early months of gestation, from any cause, may delay union of the palatal plates.

The interesting experience of Dr. Albert D. Davis of Omaha, Nebraska, with twins having congenital cleft lip and palate, furnishes a valuable contribution to the literature. His report on "identical twins" follows:

TRIPARTITE CLEFT PALATE AND DOUBLE CLEFT LIP IN "IDENTICAL" TWINS[1]

In the literature of cleft palate and cleft lip and by personal communication I have been unable to find a case where "identical" twins were both afflicted with congenital tripartite cleft palate accompanied by double cleft lip. Brophy (1) reported 6 cases of twins in which one of the twins had a cleft palate. Shearer (2) reported 3 cases of cleft palate twins, one of these was of "identical" twins in which both children, who were girls, had clefts, one having a cleft lip on the right side and the other on the left. Federspiel (3), Ivy (4), Gilmer (5), New (6) report never to have seen tripartite cleft palate in twins. Blair (7) has never seen twins with cleft lip and palate, but states that he had received a photograph of still-born twins with both cleft lip and cleft palate from Dr. F. Koontz of Louisville, Ky., and that Dr. S. Mixter of Boston had described to him a case of twins with cleft lip.

The absence of cases of tripartite cleft palate and double cleft lip in "identical" twins in the literature justifies the following case report and study of their unusual deformity:

Case History.—Mrs. T. 28 years; Dutch-American, housewife; 5 pregnancies, the first four being normal at term with living child. The fifth was a twin pregnancy, both males, born at term, living and well, and both with congenital cleft palate (Tripartite type and double cleft lip.)

Family History.—No history of cleft palate or cleft lip in the woman's father's or mother's family connections. The husband's father was normal. Husband had one sister who gave birth to a child with cleft palate and cleft lip. This sister's husband was normal with a negative family history.

Personal History.—Negative. W. R. negative. Strong robust woman. In the present pregnancy labor came on at term. First child delivered by anterior rotation; and weighed 5 lbs. 5 oz.; second child delivered by podalic version and weighed 6 lbs. ⅛ oz. Examination of the twins showed the following startling facts; both were of the same sex; the color of the eyes was the same in both; the color of the hair was identical and the crown whirls were in opposite directions; a complete tripartite cleft palate and double cleft lip was present in both. In spite of the deformities the similarity of appearance was striking. In all other respects the twins were normal and apparently healthy.

The facts described seem to place this pair of twins in the monozygotic class, *i.e.* developing from a single fertilized ovum; hence the term "identical" twins. Extensive studies of polyembryon have shown that in the lower forms of life as well as in mammals all individuals developing from a single ovum have the same sex.

In twins of the monozygotic type the question of the transmission of heritable characters is of considerable interest. In the present case the question arises whether or not cleft palate is an heritable character; and if so it must be equally shared by both twins. The appearance of the same character in monozygotic twins depends on an equal distribution of the determining factor to the two cell masses in the earliest cleavage. It seems conceivable that one early embryonal mass may receive a differentiating factor while the other does not; hence both

[1] Read before the Nebraska-Iowa Pediatric Society, Jan., 1922. By Albert D. Davis, B.Sc., D.D.S, M.D. From the Department of Oral Surgery, University of Nebraska College of Medicine. Published in Surgery, Gynecology and Obstetrics, November, 1922.

would not only not have the somatic expression of the character in question, but only one of them would have the power of transmitting it. This accounts for the occasional asymmetry observed in "identical" twins.

According to Brophy (1) all children who have congenital cleft palate, with rare exceptions, have in the palate at birth the normal amount of tissue, although it is not united in the midline. Cleft lip is a congenital fissure or fissures in the upper lip due to failure of the superior maxillary and premaxillary processes to unite with each other in early embryonal life. Cleft palate, and cleft lip occur singly but are frequently seen together.

Fig. 198.—Congenital cleft palate and double cleft lip in twins.

In classifying cleft palate Keith (8) quotes Haug's (9) series in which tripartite palate occurred in 15 per cent while in the London series there was 38 per cent. In the bi-partite type the percentages were 22 and 23 respectively. In the present case the cleft was tripartite; the premaxillary bones protruded and were separated by lateral fissures from each of the maxillary bones but joined the vomer: The case was further complicated by double cleft lip in both children.

Biological considerations show that the separation of dominant and recessive characters and their recombining to form physical entities play an important rôle in the etiology of cleft palate and cleft lip. One generation may be entirely free from the deformity only to have it reappear in succeeding generations. Family trees of cleft palate and cleft lip show that such deformities if cleftable follow no known law but may affect an entire family, a few, or even single individuals. It is well known that the greatest number are afflicted when both parents either have a family history of cleft palate or are themselves affected. Shearer (2) reports a positive family history in 95 per cent of over one thousand cases.

Failure in union of the palatal processes may be the result of malnutrition. But the exact causes of non-union are not known. The theory advanced by Boedecker of Berlin is accepted by Brophy as the best explanation yet given. This depends on the finding that in the formation of the teeth the mucosa dips deeply down into the submucosa forming the epithelial lamina, which later contracts into an epithelial cord, from the distal end of which the enamel organ arises. This intervening layer of epithelium together with the force exerted by the tongue and mandible upon the palate, with the body of the fetus in the flexed position and the masticatory muscles active, may influence non-union. The position of the fetus in utero is such

that the weight of the entire body is thrown upon the vertex, the masticatory muscles are active, and the extreme flexion of the head and neck with the tongue wedged in between the lateral halves of the maxillæ, tend to force the mandible, which in the early stages of fœtal life if united, into contact with the sternal region which forces the forming jaws together. Is now undue pressure occurs, or there is a remnant of epithelium intervening, or if there exists a state of malnutrition causing a delay in ossification or growth, or any combination of these factors it is conceivable that a permanent cleft may result.

Different opinions are held in regard to the ossification of the bones forming the palate. The maxillæ develop from the skeletal system and their centers of ossification seem to vary according to different authorities.

The palate bones commence ossification in the vertical plate about the eighth week. It is a membraneous ossification and begins at the side of the nasal cavity immediately internal to the palatine nerves. The orbital and sphenoidal processes are outgrowths of the vertical plate. The vomer arises from a bilaterally placed pair of nuclei, which appear during the eighth week near the back of the inferior margin of the cartilaginous nasal septum but superiorly they extend on each side of the septum so as to enclose the septum between two thin plates of bone. These two plates gradually fuse from behind forewards, but union is not complete until the age of puberty. Although the vomer develops on each side of the cartilaginous nasal septum and at its expense, it is regarded as a true membraneous bone. This gives approximately six ossification centers in the formation of the palate.

CONCLUSIONS

1. The pair of twins in the case now reported belong to the class of monozygotic twins.
2. Cleft palate results from non-union of parts; and at birth, with rare exceptions, the amount of tissue present is normal.
3. The etiology of cleft palate and cleft lip is not yet settled.
4. Heredity and malnutrition as causative factors, while of interest are contradictory.
5. Embryonal development of cleft palate proceeds in the normal manner except for non-union of the parts.
6. The number of ossification centers entering into the formation of the palate is still in dispute, but is probably represented by two palatal, two maxillary, and two premaxillary centers.
7. The mandibular arches unite prior to the maxillary processes, and may prevent union of the maxillary processes by flexion of the chin on the sternum causing pressure on the palato-alveolar inclined plane of the un-united maxillæ.
8. I have been unable to find in the literature any case of tripartite type of cleft palate in "identical" twins.

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Regarding the etiology of cleft palate, it is interesting to note the observation made by Dr. O. A. Strauss, who was engaged in the study of the abnormalities of animals in the zoölogical gardens at Berlin, October, 1913.

In 1909 32 jaguars were born of one mother by the same sire within a period of one year. All of these animals had cleft palate and all died. At that time they were fed cold meat from which the blood had been allowed to escape. Three years later, the diet was changed and the parent animals were fed with meat which was still warm and which contained blood. Since that inauguration there were two litters a year (about 25 jaguars), not one of which had a cleft. Petrus Olson, in charge of the animals, stated that he was able to eliminate cleft palate and lip in all the animals of this family. It would be interesting to work out a system of diet in the human race, especially in those families in which there is a marked tendency for cleft palate and cleft lip to appear.

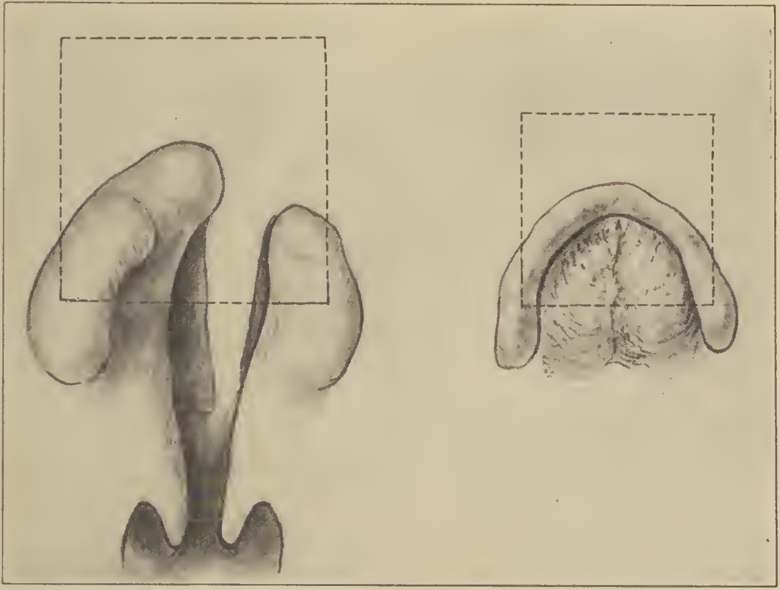


FIG. 199.—Diagram showing that a cleft palate is wider than a normal palate. Anteriorly, the cleft is wider at birth than it is posteriorly.

Exciting Causes.—In early embryonal life, between the second and third months, the tongue fills the whole mouth. As late as the latter part of the second month, it is much thicker than at birth and is kept between the hemispheres of the maxillæ. In the young infant it is almost constantly thrust up between the palatal plates and into the nasal passage (Fig. 204) crowding the maxillæ apart, while the mandible, as soon as the muscles of mastication become active, brings pressure on the palato-alveolar inclined planes of the un-united maxillæ and, acting as a wedge increases the separation, widening the breach. The flexed position of the head, with the symphysis of the mandible resting on the sternum, may contribute to some extent to the force which is exerted by the mandible

on the palatal arch and thus force the bones upward and apart. There is a specimen in the Museum of the Royal College of Surgeons, London, showing the tongue adherent to the anterior part of the cleft palate. Having performed over 5000 cleft palate operations (August, 1920) 1844 of which were upon infants under six months, I have found that the upper jaw, in comparison with the lower, is much broader than it should be and as a rule the horizontal plates are more or less elevated. *When we*

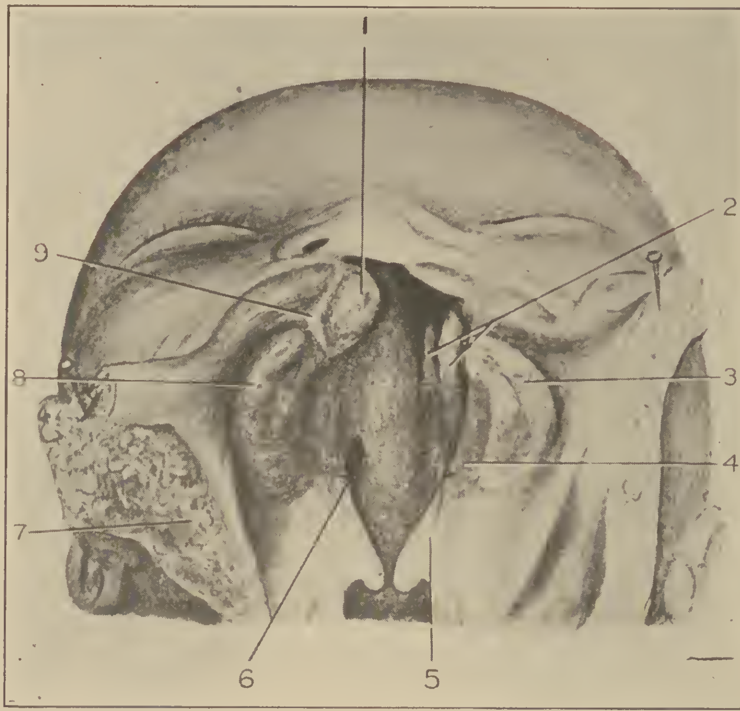


FIG. 200.—Single left complete cleft palate with harelip. (*From a specimen in the Museum of the Royal Free Hospital.*) 1. Premaxilla: 2. Middle and inferior turbinated bones; 3. Alveolus of the left side; 4. Hard palate; 5. Soft palate; 6. Posterior end of the septum of nose; 7. Cheek turned back; 8. Alveolus of right side; 9. Frænum. (*Berry and Legg*, 1912.)

bring the borders of the fissure into contact, we have brought the upper jaw back to its normal breadth and into its proper relation to the lower jaw. There are very few exceptions to this statement. In young infants, who have cleft palates, I have *always found* that by slightly forcing the chin upward, the pressure of the lower jaw against the segments of the upper jaw *will spring the cleft bones farther apart.* The anterior part of the fissure is always wider than the posterior part, at birth in single cleft palate, and remains so until the teeth are erupted when the pressure exerted by the occlusion of the teeth forces the tuberosities of the maxillæ farther apart (Fig. 238). Authors who have given a great deal of thought to the subject

and who have dwelt at great length on its etiology, those who have proposed a generous use of phosphatic food for the mother during the period of gestation, have been unconscious of the fact that *the bones are not, as a rule, defective in structure nor incomplete in development. There is only abnormal elevation of the palate and failure of union* (Figs. 227 and 228).

The three figures here exhibited are taken from the work of Berry and Legg. The legends are reproduced also. Figures 200 and 201 point out in no uncertain manner the fact that the anterior part of the cleft is wider than the posterior. They also show the deformity of the nose, with broad, flattened nostril.

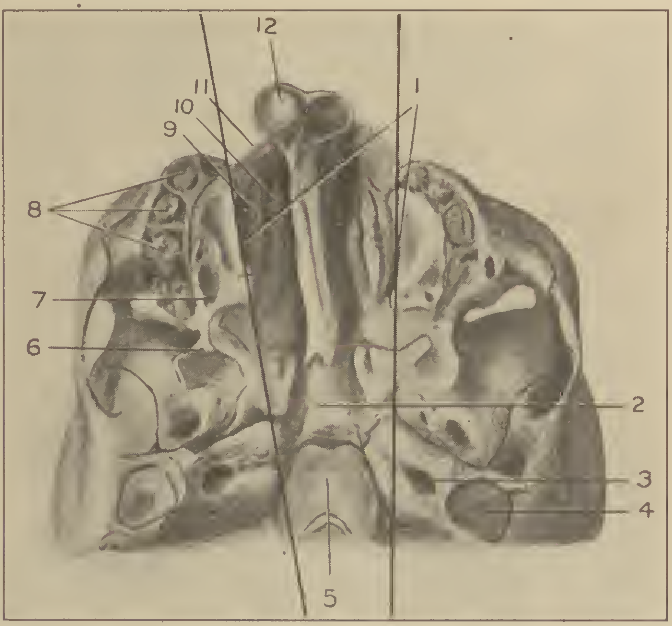


FIG. 201.—Base of skull of a new-born infant with double complete cleft palate. (*Natural size.*) 1. Edges of bony palate; 2. Basi-sphenoid; 3. Jugular foramen; 4. Membrana tympani; 5. Basi-occipital; 6. Hamular process; 7. Posterior palatine foramen; 8. Germs of milk teeth; 9. Inferior turbinated bone; 10. Middle turbinated bone; 11. Edge of bony nostril; 12. Premaxillary process with germs of central incisor teeth. Note the absence of the lateral incisors. (*From a specimen kindly lent to us by Dr. Johan Ulrich of Copenhagen.*) (*Berry and Legg*, 1912.)

Fig. 202 shows the premaxillæ in prominent position and the double cleft shows from before backward. It will be seen, by measuring this cleft, which is of natural size, that the anterior part, as in Fig. 200, is a great deal wider than the posterior part. I cannot conceive how an operation could be made successfully in a case like this without moving together these separated bones. If the patient had attained an age of 4 or 5 years, this might be done by slow process, as in cases shown in Figs. 328 to 332.

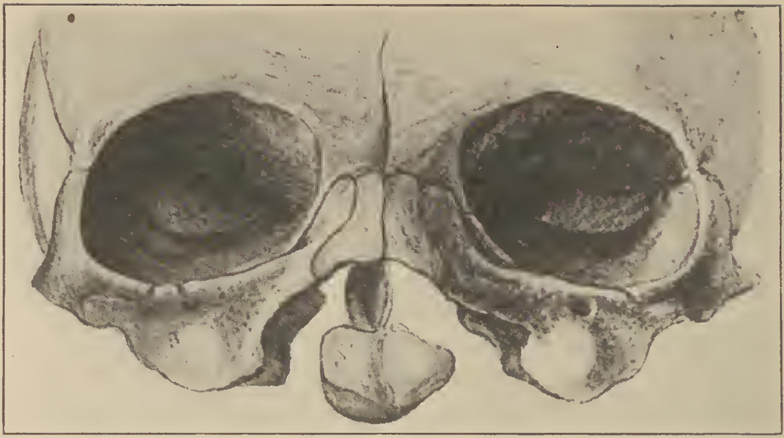


FIG. 202.—The preceding seen from the front. *(Natural size.)* *(Berry and Legg,* 1912)

FIG. 203.—It may seem superfluous to introduce any more illustrations on this very common deformity. This one, however, has attached to it unusual interest. It is not a drawing, the product of a fertile mind which was faithfully used to imitate his model, but this is Nature, with no chance whatever for a deviation from the conditions which existed in the subject.

I procured a stereopticon slide from which this was made, with many others kindly furnished me by the late Dr. W. B. Pearsall who, at the time this picture was procured lived in Dublin. When I appealed to him for pictures, he kindly put himself to work and sent me about 25 slides which, through the years, I have used in illustrating this congenital defect. This picture was obtained from Manchester, England.

It will be seen that this figure shows that the horizontal incision was made from before backward through the corners of the mouth, separating completely the head so as to bring into observation the cleft of the palate. Here, like the others illustrated, we find that the cleft in the anterior part of the fissure is very much broader than it is in the posterior part.

It will be remembered that the mandible develops from two ossific centers and unites at the symphysis. Failure of union would cause a fissure in the lower lip. The students of etiology of cleft palate have

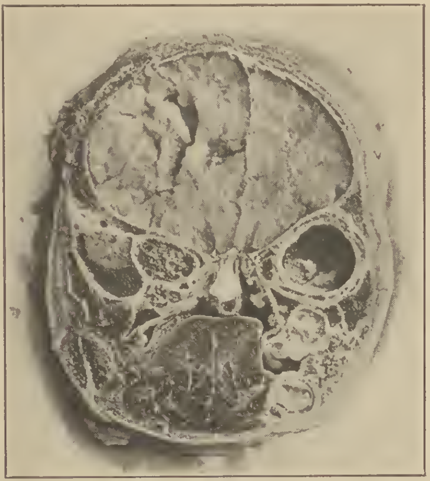


Fig. 204.—A longitudinal section of the head of an infant cadaver, showing the tongue occupying nearly all of the nasal passage, and on the right side, extending up near the floor of the orbit. It will be noticed that the palatal plate of the right maxillary bone has been lifted to almost a perpendicular position, while the palatal plate of the left maxillary bone has been turned upward and outward so that its surface which should approximate with its fellow of the opposite side is in contact with the naso-antral wall just beneath the inferior turbinated bone. It is very apparent that the extreme breadth of the fissure between the maxillary bones has been in great part due to pressure of the tongue in embryonal life. (*Stone, Boston Medical Journal.*)

Fig. 205.—Palatal surface of mouth of child five weeks of age showing extensive cleft of hard and soft palate and unilateral cleft lip.

Fig. 206.—Palatal surface of same mouth one week after operation for closure of cleft of the hard palate.

never explained why cleft of the mandible, with fissure in the lower lip, does not often occur. This is accounted for by the fact that the alveolar ridge

of the mandible comes in contact with the inclined planes forming the upper arch and the elements of the mandible are thus approximated and unite. If the maxillæ met the lingual surfaces of the mandible instead of the buccal, the force exerted would cause cleft of the mandible with fissure in the lower lip.

Supernumerary Dental Rudiments as a Factor.—In 1899 Professor Warnekros published a paper, in which he noted the frequent occurrences of supernumerary teeth in congenital clefts. Since then he has published the results of a more extensive study, in which he maintains that these clefts are due to rudiments of supernumerary teeth (Figs. 207 to 210). He has modified his former view, that cleft palate is caused by failure of the maxillæ and intermaxillæ to unite and he now believes that the cleft

Fig. 207.—Case 5984. (*Warnekros.*)

originates in the intermaxillary bones. It is certainly a fact that supernumerary dental rudiments have been observed by various investigators without attracting especial attention (Figs. 211 and 212). Warnekros presents, in support of his theory, serial sections showing that the tooth rudiment always precedes the bone rudiment in cases where the supernumerary teeth appear atavistically. Serial sections of an embryo 8 cm. in length show the rudiments of the normal lateral incisors already highly developed at a time when ossification of the premaxillæ had not yet been completed. This theory agrees with the position maintained by Albrecht and others that the incisor teeth were originally six in number; thus a supernumerary lateral incisor would be a reversion to type. Warnekros explains the relation of heredity by maintaining that in families where cleft formations are found, it is always possible to discover a tendency toward the development of supernumerary teeth. He has confirmed this in a number of cases.

The late Dr. M. H. Cryer, in his work on "Studies on the Internal Anatomy of the Face," speaking of the relation of the two jaws, states: "Various theories have been advanced for this lack of union, the most prominent, perhaps, being that of malnutrition of the parts during the time when union should take place. While agreeing that malnutrition is

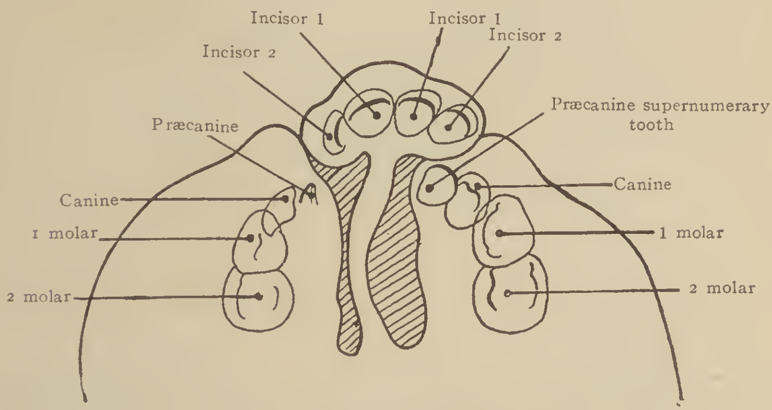


FIG. 208.—Case 5984. (*Warnekros.*)

probably largely responsible, the author offers as a plausible explanation of the manner of its operation the idea that as the lower jaw is formed in advance of the upper one, *when undue pressure is exerted upon it, it is forced in between the four processes forming the upper jaw, thus mechanically preventing them from coming together.* The normal position of the fetus

FIG. 209.—Case 5984. (*Warnekros.*)

in utero is such that the weight of the entire fetal body may be readily thrown upon the vertex, and the pressure thus exerted would *tend to force the mandible into contact with the sternal region and compress the forming jaws together.* The relatively advanced development of the mandible,

FIG. 210.

FIGS. 207 to 210.—Case 5984 shows the cleft on both sides, with the snout-like protrusion of the lip and the cleft intermaxillary bone; the skiagram and diagrammatic view demonstrate that the cleft is intra-incisive, and there is present on each side of the double-sided cleft a precanine supernumerary tooth. (*Warnekros.*)

FIG. 211.—Plaster cast of a cleft palate patient who has a supernumerary cuspid tooth. (*Warnekros.*)

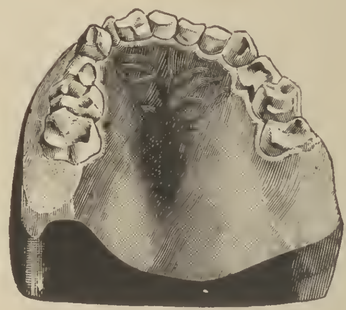


FIG. 212.—A plaster cast of a cleft palate patient who has a supernumerary lateral incisor tooth. (*Warnekros.*)

FIG. 213.—A study of the relation of the lower jaw and the tongue to a normal, and to a cleft palate. The normal palate is illustrated by a coronal frozen section, the cleft by a coronal section of a plaster reproduction of a single cleft palate. The arrows point to the alveoli in both sections. Notice that in the normal palate the lower jaw is slightly wider than the upper and that in the cleft palate the lower jaw has risen up and is wedged in between the two halves of the maxillæ. In the normal palate section the mouth is partially open. (*Blair, Dental Era, about* 1908.)

as compared with that of the forming maxilla, would, under the circumstances referred to, and especially in cases of low nutritional standard,

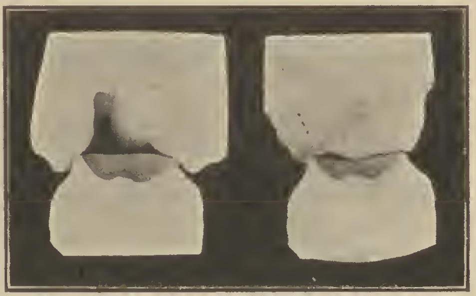


FIG. 214.—A, Author's cast of complete cleft palate in an infant showing relation of upper and lower jaws. The upper is wider than the lower, causing the latter to act as a wedge constantly separating the segments of the upper jaw. B, model of the same patient after operation. This shows that the cleft has been closed and the bones moved together, thus establishing the normal relations of the upper with the lower arch.

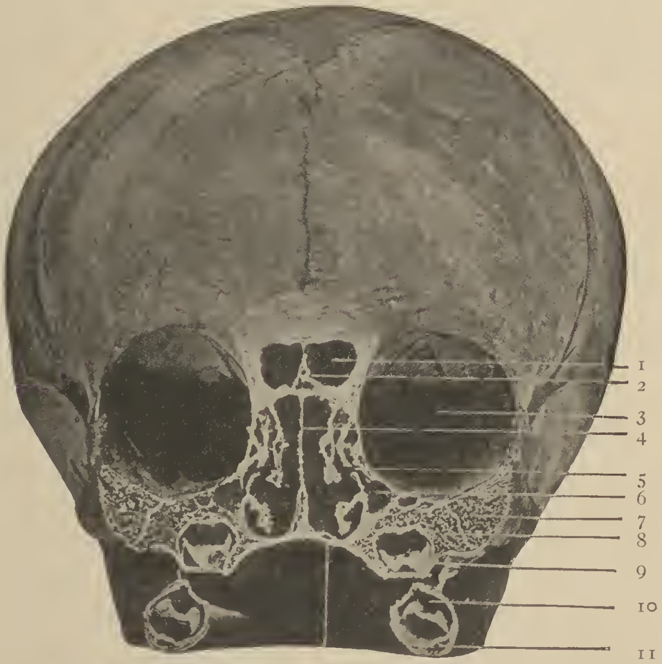


FIG. 215.—Skull of a fully developed embryo cut vertically through the first deciduous premolars. 1, Anterior fossa of brain-case; 2, crista galli; 3, orbit; 4, nasal septum; 5, osteum maxillare; 6, maxillary sinus (antrum); 7, malar bone; 8, maxilla; 9, dental germs; 10, mandible 11, hard palate. (*Cryer.*)

interfere with the normal closure of the branchial arches and tend to produce a permanent coloboma. If an examination be made of a young

child with a complete cleft, it will be noticed that the upper alveolar ridge is immediately over the alveolar ridge of the lower jaw, or it may be slightly external to it (Figs. 213 and 214).

It is generally accepted that the lower jaw acts as a matrix or mold upon which the upper jaw is formed. Certainly to an extent it becomes the mold upon which the inferior border of the upper jaw is formed, as the latter comes in contact with its inner edges. This action also influences the general contour of the superior alveolar ridge and roof of the mouth.

Fig. 215 is a picture taken from the skull of a fully developed fetus. The skull has been cut *vertically and transversely* in the region of the developing deciduous teeth of both jaws, showing the jaws in transverse section. The skull is quite symmetrical. It is plainly to be seen that the width of the upper jaw is much less than that of the lower. As a further

Fig. 216.—This shows the relation of the upper and lower jaws at birth. It will be noted that the mandible is wider than the maxillæ. (*Harrison.*)

Fig. 217.—Anterior view of a vertical transverse section through the lower jaw and the lower portion of the upper jaw. (*Cryer.*)

evidence of this fact, if vertical lines are drawn through the center of the tooth-germ and the alveolar process of each jaw, it will be found that the lines of the upper jaw are on the inner side of those of the lower jaw, the extent of the difference being about one-half of the thickness of the lower jaw. Fig. 217 is taken from an adult jaw. If the lines be drawn through the axes of the upper and lower teeth, it will be found that those through the upper teeth, as they extend through the coronal surfaces, pass a little outward, while those passing through the lower teeth incline inward. This is evidence that the relation found in the fetus has been continued and that all through the period of growth of the lower jaw and development of its alveolar process, the latter has been directed inward, while the upper alveolar process has extended outwardly so that the cusps of

the upper permanent teeth, when fully developed normally, bite over the outer cusps of the lower teeth occluding with them. *If the teeth and alveolar process be excluded, it will be observed, as in the fetal skull, that the upper jaw is much smaller than the lower.*

In the young adult the upper alveolar ridge is in vertical line with that of the lower. In one of advanced age the mandible is a great deal broader than the maxillæ (Fig. 218)."

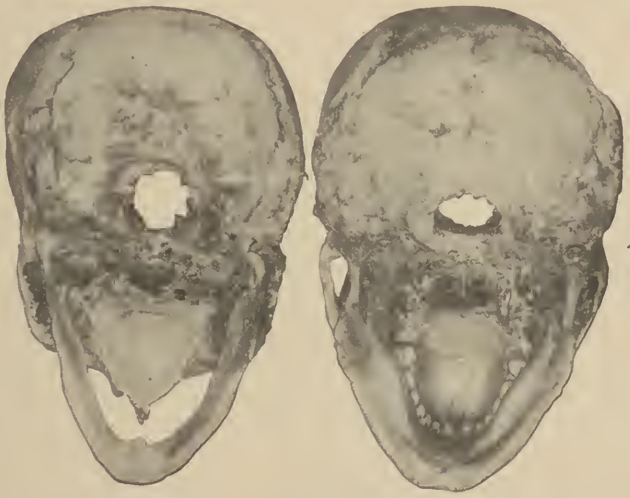


FIG. 218.—Under view of two adult skulls. *A* is from a subject about twenty years old; *B*, from one well advanced in years. In both of these it is seen that the mandible is very much wider than the maxillæ. (*Cryer.*)

In a very interesting article Sir Arthur Keith,[1] Director of the Museum of the Royal College of Surgeons, London, makes the following statement: "In 555 cases at the clinic of von Bruns at Tubingen, Dr. Gustaf Haug found that the tripartite palate occurred in fifteen per cent. against thirty-eight per cent. in the London series, bipartite palate in twenty-three per cent. against twenty-two per cent. in the London series; and unilateral harelip with no cleft of the palate, forty per cent. against nine per cent. in the London series. In tripartite palate, which must be regarded as the most severe form, the three elementary parts of the palate are widely separated. In all cases the lesion is remarkably alike, a typical

[1] Arthur Keith, M. D., British Medical Journal, Aug., 1909, on Congenital Malformations of the Palate, Face, and Neck. In this connection, I wish to express my appreciation of the great kindness shown to me by Dr. Keith in exhibiting large and valuable collections of congenital deformities, including cleft palate and cleft lip, in the Museum of the Royal College of Surgeons.

example being shown in Fig. 219. In the middle element from before backwards are to be recognized (1) the middle part of the upper lip, (2) the premaxillary part of the palate, carrying the incisor papilla which is joined to the upper lip by a fraenum, (3) the lower border of the septum of the nose, which is wider, shallower and longer than the normal, (4) the varying number of dental sacs on the premaxilla. In sixteen cases only the two middle incisors are carried, in three cases one lateral incisor as well as two middle (as in the specimen shown in Fig. 219), and in four cases

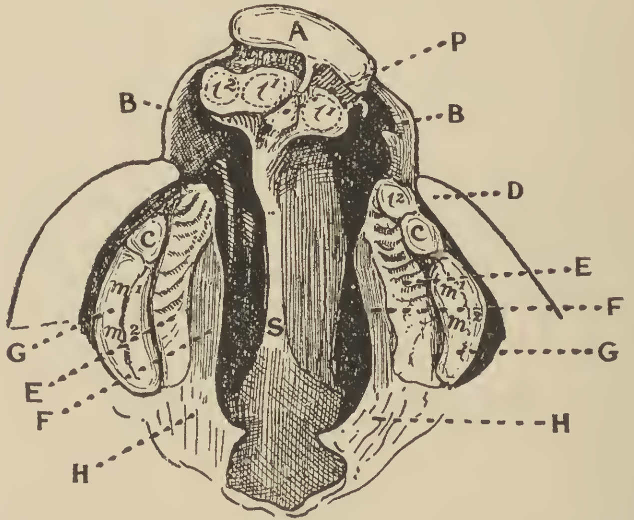


FIG. 219.—Tripartite palate. *A*, Median part of upper lip; *B*, *B*, alæ of nose (two tags on left); *C*, canine tooth buds; *D*, lip; *E*, rugose part of palate; *F*, marginal part; *G*, alveolar part; *H*, soft palate with uvular process; I^1, I^2, incisors; *P*, incisive papilla; *S*, septum. (*Keith.*)

all four incisors. In none did the premaxilla show a suture between the ectognathic and the mesognathic part. The nerves and vessels of this element are the naso-palatine. On each lateral or maxillary element, three distinct areas can be recognized: (1) the alveolar area on which may be seen an elevation over the sacs of the two milk molars, another over the canine and, frequently, a third often on the margin of the cleft over the lateral incisor; (2) a plicate or rugose area marked by folds; (3) a smooth, narrow marginal area (Fig. 219). When the mucous membrane is removed, the maxillary or lateral element is seen to be supported by the superior maxilla and palate bones. The nerves and vessels of the maxillary elements are the descending palatine."

TABLE I.—CLASSIFIED LIST OF SPECIMENS SHOWING CONGENITAL CLEFTS OF THE PALATE AND UPPER LIP IN METROPOLITAN MEDICAL MUSEUMS

	A	B	C	Total
1. Palate cleft into three parts	14	12	2	28
2. Palate cleft into two parts	3	12	2	17
3. Median cleft extending from the premaxilla to the uvula	4	3	7	14
4. Cleft of soft palate	3	0	0	3
5. Cleft of uvula	4	1	0	5
6. Cleft on both sides of premaxilla	1	0	0	1
7. Cleft limited to one side of premaxilla	1	0	1	2
8. Median cleft due to absence of premaxilla	1	2	4	7
9. Bilateral harelip	1	0	3	4
10. Unilateral harelip	0	6	0	6
11. Median harelip	0	0	0	0
	32	36	19	87

A. Specimens in the Museum of the Royal College of Surgeons of England.

B. Specimens in the museums of metropolitan medical schools.

C. Specimens of cleft palate in mammals other than man, chiefly in the Museum of the Royal College of Surgeons of England.

The Degree of Separation between the Various Parts of the Palate.—Professor Keith further states that "The late Professor His was of the

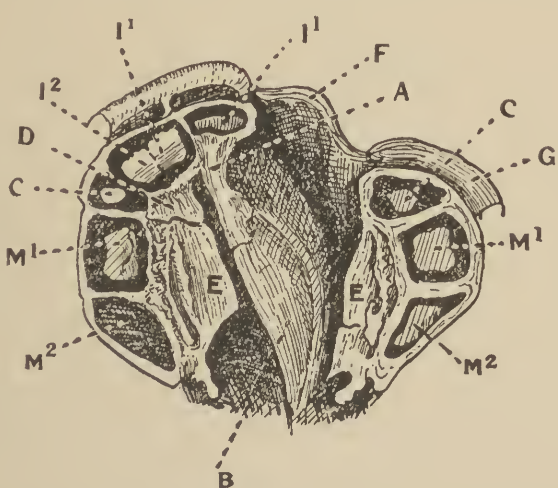


FIG. 220.—Bipartite palate. *A*, Septal process of premaxilla; *B*, vomer; *C*, canine; *D*, premaxilla; *E*, marginal part of palate; *F*, ala of nose; *G*, maxillary part of lip; I^1, I^2, incisor teeth; M^1, M^2, milk molars. (*Keith.*) The anterior part of a cleft palate is almost invariably a great deal more widely separated than the posterior part; an extreme example of which is seen in Prof. Keith's figure above. (*T. W. B.*)

opinion that cleft in the palate resulted from irregular and in-coördinated growth of the three elements which go to form it. That the growth of the

three parts is irregular in the latter months of fetal life there can be no doubt. (See Figs. 187 and 219.) The septal part of the mesial nasal process is abnormally long so that the premaxilla projects some 6 to 8 mm. in front of the maxillary part of the palate. The increase in length of the septum is due not to the vomerine part of the septum, but to that part of it which is formed by the premaxillary part of the process (Fig. 221). If the premaxilla becomes adherent to the maxilla on one side, the extra growth of the septum still takes place, with the result that the premaxilla is bent towards the side on which union takes place (Fig. 210). Irregularity of growth is not the cause, but the result, of the cleft condition.

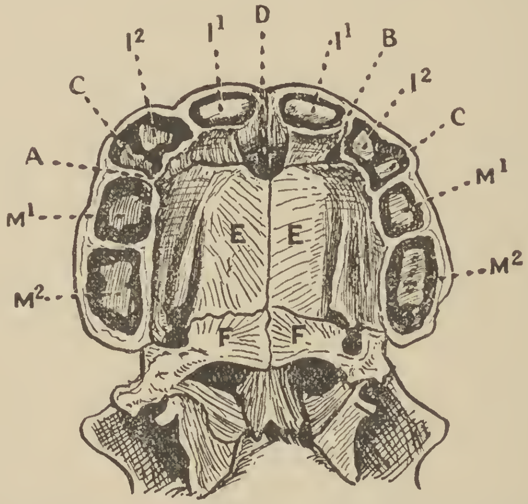


FIG. 221.—Palate of newly born child (natural size) to show the elements entering into its formation. *a*, Suture between premaxilla and maxilla ending behind canine tooth; *b*, the same ending behind central incisor; *c*, canine; *d*, vomer appearing in naso-palatine fossa; *e*, marginal part of maxillary palate; *f*, horizontal process of palate bones. (*Keith.*)

From the evidence to be produced, it is probable that the processes which form the palate were in contact during the fifth and sixth weeks of development, but, for some reason, the exact cause we do not know, union did not take place then. The union of the embryological processes is comparable in every way to the healing of wounds; the epithelial coverings on each side of the nasal groove come in contact and form a bridge across which the uniting mesoblasts may grow. If, for some reason, union is delayed—and from Professor Mall's observation there can be no doubt that uterine inflammations, sometimes from syphilis, is the most common cause—growth in the several elements of the palate causes them to separate, and once the breach in their continuity has been effected, union cannot take place afterward. The younger the fetus, the smaller the cleft, not only absolutely, but relatively. The width of the fissure between the palatal

processes of the superior maxilla varies from 7 to 20 mm. in the tripartite palate; 14 mm. is the average in eight full term children; in a fetus of the fourth month this cleft measured only 1 mm.

Brophy has suggested that the subsequent separation is caused by the pressure of the lower jaw and tongue against the palate. The material at my disposal is in harmony with his suggestion. He also makes the statement that there is no atrophy of the parts that go to form the palate, but this is certainly not the case in the specimens that I have examined. In three palates of adults the cleft was on the average 20 mm. wide, the breadth of the palate 64 mm. The bony parts of these palates were thus 10 or 15 mm. less than normal. In newly born children the deficiency affects the inner or marginal area of the palate (Fig. 219), but it does not amount to more than 3 mm. on each side. Whether the cleft continues to increase after birth, I am not in a position to say, but, judging from the width of the cleft in the adult palate, I conclude that the parts do not continue to separate after birth at the rate they did before birth."

In a previous paper[1] I made the following statement: "If the muscles are very early brought into action, they develop instead of atrophy, hence a good velum is secured, with plenty of tissue; whereas, if the operation is undertaken later in life, the parts are undeveloped through non-use and they cannot so easily be made to subserve the same purposes that tissues, which develop through natural employment, can be made to do." It will be seen that I have not said "there is no atrophy of the parts that go to form the palate." I hold that *at birth* the normal quantity of tissue is nearly always present but often misplaced. Later in life the arch is so widely spread that the palate is shortened when closed and besides, if not united by early surgical operation, may fail to develop. This condition may easily lead the observer to conclude that there has been atrophy of parts, although the fact exists that they have not been put to use and, therefore, have not grown in proportion to the tissues which *are* in use.

In a personal communication bearing upon the condition of complete cleft palate in infants, Sir Arthur Keith writes: "I agree with you that *in the majority of cases of complete cleft of the palate, there is no deficiency of tissue at birth nor for some time after birth. I also agree that the cleft, however wide, is not due to a deficiency of tissue in the several elements which form the palate, but is entirely due to the fact that when the various embryonal parts or elements are developed and come together in the second month of development, the process of union, which should occur then by a means similar to union by first intention, is delayed and does not take place, hence the several palatal elements, being in-coördinated by union, tend to separate as growth occurs, the cleft increasing during each month of growth. The exact cause of the*

[1] Read before the American Surgical Association at St. Louis, Mo., in 1904.

separation of the parts and the enlargement of the cleft is probably due to several factors, tongue pressure, muscle traction and also the independent process of growth in each individual part.[1] Theoretically, the best treatment ought to be to bring about union at the very earliest date, but theory and practice may not be easily harmonized. To lay down the lines of treatment is beyond my province and my experience. I simply note the fact that three men whose opinion I value—yourself and Arbuthnot Lane on the one hand and James Berry on the other—have reached diametrically opposite conclusions as to which is the best time to operate. Still, that does not influence me in agreeing with you that to secure a good palate *the sooner the cleft is remedied in complete cases, the better the result ought to be.*" I regard the statements of Sir Arthur Keith as further proof of the declaration made by me many years ago, that *cleft palate is not the result of arrested development or insufficient tissue to form a normal palate*, the views of many authors to the contrary notwithstanding. I am sure that anyone interested enough to enter into a careful investigation of this subject, no matter what his previous opinions may have been, will be convinced that *at birth a cleft palate, with rare exceptions, has in it sufficient tissue to form a normal palate and that the abnormality is only a separation, and elevation of well-developed parts.*

"**Imperfect Degrees of Union.**—In Fig. 222 there are shown very imperfect strands of union between the premaxillary and maxillary processes. A study of these throws much light on the condition of cleft palate. The slightest degree of union is shown in Fig. 222, *A*, where a strand of fibrous tissue covered with epithelium unites the ala of the nose to the premaxillary process. This represents the rudiment or, rather, vestige of the union of the mesial and lateral nasal processes to form the boundary of the anterior nares. In b, c, and d, Fig. 222, increasing degrees of union are shown. In the fullest degree the uniting band forms a bridge on which four elements end in attempting to reach the premaxillary process—(1) the ala of the nose, (2) the lateral part of the upper lip, (3) the dental groove, (4) the palatal process of the upper maxilla. These strands of union have become stretched, apparently, by the unequal or irregular growth of the parts which go to form the palate or upper lip. Occasionally blunt conical processes occur on each side of the cleft, evidently the remnants of a strand which has broken under the strain." (*Keith.*)

Condition of Cleft Palate in the New-born.—As to the condition in the new-born child, we find these parts not only separated, but the plates forming the hard palate are elevated to an almost vertical position by the pressure of the mandible and tongue (Fig. 223), and that elevation naturally moves the separated edges farther apart than in the vault of normal height

[1] Italics mine.

(Fig. 224). The action of the pressure of the tongue against the palatal plates before and after birth may be easily recognized as in an infant with

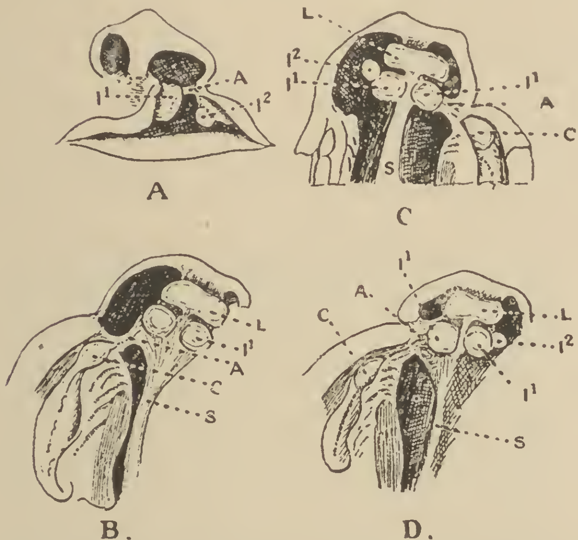


FIG. 222.—Four specimens of cleft palate showing various degrees in the development of the band between the premaxillary, maxillary and lateral nasal elements. *A*, The bond or bridge of tissue crossing the cleft; l^1, central incisor sac; l^2, lateral incisor sac; *C*, canine sac; *L*, median part of upper lip; *S*, septum of nose. (*Keith.*)

FIG. 223.

FIG. 224.

FIG. 223.—Vertical section of cleft palate, infant's head, showing the enormous breadth of the upper jaw and nares. The upper jaw is seen to be very much wider than the lower. (*From Stone.*)

FIG. 224.—Vertical section of normal infant's head showing the relation of the lower to the upper alveolar borders. The upper and lower jaws are of the same width.

cleft palate the tongue is almost constantly in the fissure extending up into the nasal cavity (Fig. 204). To establish a law in connection with the subject,

a great many specimens must be examined. I am convinced that an accurate measurement of the palatal surfaces of the separated bones will show that the distance between the borders of the cleft and the center of the alveolar processes presents as broad a surface as will be found in the bones of a child of the same size, whose palate is normal. When, by reason of the pressure of the tongue and mandible against the alveolar inclined planes, the separated bony plates are carried upward to an extreme height and laterally, the distance, naturally, is greater, as illustrated, than it would be if these plates were in their normal position. I am aware that

FIG. 225.—Cleft palate with absence of horizontal plates of palate bones in an adult is usually regarded as inoperable. Blair's operation, however, by reflecting flaps from the neck may close the palate. (*Carmody.*)[1]

occasionally we find an absence of nearly all of the hard palate (Fig. 225). This is not the result of atrophy but of failure of development of the bones. These cases, however, are extremely rare.

Relation of Incisor Teeth to the Cleft.—In the very careful study that Professor Keith has given this subject, he has brought statistics of inestimable value to the attention of the profession. He has pointed out, in the study of the relation of the incisor teeth to the cleft, that the cleft usually lies between the central and lateral incisors. In doing this, he has set aside the view held by some authors that the cleft is almost invariably between the lateral incisors and the cuspid teeth. He states that out of forty-three cases twenty-three showed the fissure passing between the central and lateral incisors, in nine it passed between the lateral incisor and cuspid teeth, and in

[1] This rare specimen was kindly furnished to me by Dr. Carmody.

seven cases the lateral incisors had not developed on the sides of the fissure, while in two a third incisor, or supernumerary tooth, was developed. The teaching of Albrecht, who endeavored to explain the varying relations of the fissure to the incisor teeth, presumes that the premaxillæ are developed in two parts, one part carrying the central incisors and the other the lateral incisors. In my early experience I believed that the suture existed between the lateral incisor and cuspid tooth; but in the light of a larger experience and closer observation I am satisfied that the suture far more frequently occurs between the central and lateral incisors. In one case

FIG. 226.—Plaster cast with anterior maxillæ widely separated. The premaxillæ protrude rather extensively; besides, on careful examination they were found to contain but one central incisor tooth.

in my practice the premaxillæ contained but one central incisor tooth (Fig. 226). It was shown by Koeliker and His that Albrecht was wrong in his conclusions that the lateral nasal process did not enter into either the palate or the lip. We know that occasionally the premaxillæ are divided in such a way that there are four parts instead of two, but this condition is not constant.

Bipartite Palate.—Professor Keith, in describing the bipartite palate, or palate having only a single defect of the anterior part, separating the premaxillary from the maxillary bone on the one side, while on the other union

is complete, states that out of fifteen cases the cleft passed to the left in eleven. Haug found it on the left side in 149 cases out of 216. My own experience would give the cleft on the left side in a very much larger per cent. of cases. The question has never been settled as to why the cleft occurs with more frequency on the left side.

FIG. 227.—Author's cast of anterior h lf of adult cleft palate showing abnormally high arch.

FIG. 228.—Cast of posterior part of same cleft.

Intermaxillary Clefts.—In regard to the intermaxillary clefts, Professor Keith says: "As we have seen, the union of the premaxillary element with the alveolar parts of the maxilla marks a distinct stage in the evolution of the palate, a stage well seen in amphibians. The next stage—the mammalian—lies in the development and union of the maxillary palatal processes

already to be seen in the amphibian palate. One would expect arrests to occur in the passage from the amphibian to the mammalian stage, although such specimens are comparatively rare in museums (of the fourteen cases on my list, seven are from the human subject, the others are from the dog, ion, sheep and calf); they are the more common form of cleft palate met with in practice. Mr. J. Berry records a list of sixty-seven cases, of which thirty-six were due to non-fusion of the maxillary processes in the roof of the mouth. In these cases there is a real arrest, not only of the fusion of the processes, but of their actual growth.[1] Clefts of the soft palate alone or of the uvula alone, as may be seen from Table 1, are comparatively rare. I have seen three of the former and five of the latter.[2] They indicate an arrest towards the end of the development of the palate when the fetus is about 50 mm. long and entering the third month of intra-uterine life. Even when the palate is completely cleft the two halves of the uvula are clearly indicated as tags projected from the borders of the palatal folds. The dissection in the College Museum shows the tensor and levator palati muscles well developed; the upper parts of the superior constrictor and palato-pharyngeal muscles are stronger than in normal palates."[3]

Among the many causes that have been assigned for failure of union of the palate within the first two months of embryonal life, the one advanced by the late Dr. C. F. W. Bödecker of Berlin is based upon physiological and anatomical grounds. We know that in the formation of the teeth, the mucosa dips deep down into the submucous tissue, forms the epithelial lamina, which contracts into the epithelial cord at the distal end of which the enamel organ is formed. It is too well known to admit of discussion that a layer of epithelium under certain conditions will form an obstruction to union of the tissues which it intervenes. The illustrations (Figs. 189 to 197) clearly present the passage of epithelium deep into the connective tissue in the enamel formation. It seems that Bödecker's theory, namely, that this epithelial cord delays union of the parts forming the maxillæ and the force exerted by the tongue and mandible from the beginning of the second month until birth and several months later, account for the abnormal elevation of the palatal plates and broad separation of the maxillary bones and the creation of cleft palate.

Early Symptoms.—A new-born child usually weighs more at birth than it will a few weeks later, but a cleft palate child often continues

[1] The extreme height of the separated hard palate and the corresponding breadth of the cleft presents an appearance of absence of tissue. If the elevated hard palate were lowered to its normal position it would be quite wide enough to close the fissure (Figs. 227 and 228).

[2] My experience is not in accord with Professor Keith's findings in his Table 1 in clefts of soft palate and uvula. I have found this defect occurs more frequently than shown in Professor Keith's record.—T. W. B.

[3] Hence the value of these muscles in lengthening short palates.—T. W. B. (see page 253).

to lose weight. The loss of weight is due to defective deglutition and resulting malnutrition and, not infrequently, to improper food. Lack of knowledge regarding infant food and feeding is very common. In the absence of cleft lip, the deformity of cleft palate is often not discovered for several days—sometimes weeks. This is a great oversight on the part of the obstetrician and nurse. It is the duty of the attending physician *to make a careful examination of every child at birth* to discover possible defects or abnormalities of any nature. An examination of the mouth having been neglected, the first indication of a cleft palate is difficulty in swallowing and regurgitation of food through the nose. Consequently, the child is irritated and distressed by its inability to receive proper nutrition. It develops gastroenteritis, loses weight, becomes emaciated and may die of starvation.

Symptoms in Adults.—Cleft palate in patients later than infancy, when accompanied by cleft lip may be suspected by the casual observer, but he may readily be misled in assuming that one who has cleft lip also has cleft palate, as he may think these deformities are always associated. Those who have perfect lips and defective palates sometimes speak quite well, while many who have perfect lips and perfect palates speak with the nasal intonation which characterizes a cleft palate. The voice, therefore, is not an infallible symptom. An ocular examination quickly reveals the condition of the parts. Patients having cleft palate utter the vowels and most of the consonants distinctly. The great difficulty lies in producing the guttural, labial, etc., sounds (see Phonation).

Preparation of Patient for Operation.—The first consideration before operation is to look to the general condition of the patient. I am sure it has been the experience of every surgeon that infants who have a cleft palate are badly nourished. The open palate makes it impossible for the child to draw its milk and what little it may get often regurgitates through the nose. For this reason the child is greatly irritated and loses weight, making it a poor operative risk. Steps should be taken immediately to aid the child in swallowing its food by the use of a cleft palate nipple or velum which is employed in conjunction with the breast (Figs. 459 and 460). For a short period before operating feeding should be by use of a drop tube or spoon as the nipple cannot be used until two weeks after operation. Lawson Tait has stated that the mortality of children who have cleft palate is so great by reason of their failure to secure proper nutrition that an early operation is desirable. Many mothers, who make use of bottles for feeding infants, have not the proper knowledge of sterilization and, as a consequence, children soon develop gastro-enteritis, which must always be cured before an operation is attempted. The first duty of a surgeon, on receiving a patient for operation, is to call

in consultation a pediatrician with whom he will study its physical condition, see that it is gaining weight, that all the organs of the body are performing their functions normally, that its general condition is favorable and operate only after he is satisfied that his patient is not ill. The services of the pediatrician should be received by the patient in preparation for operation and until dismissed from the hospital.

Fig. 229.—Author's case of cleft palate with webbed fingers and toes and divergent strabismus.

Acidosis, when it exists, should be corrected. A child having acidosis tolerates an anesthetic poorly. I am sure that fatal results are sometimes due to administering anesthetics to acidosis patients. Bicarbonate of soda should be given, in proportion of one dram to three ounces of water in half dram doses every three hours, to children for eight to ten days before operating.

A study of the thymus gland is of great importance. We know that status thymico-lymphaticus is a serious menace to surgical procedure in young children. I do not regard the surgical risk as great in infants under 5 months as between 6 months and 3 years. In December 1919 I lost a patient 18 months old, following an operation. The patient had been prepared as usual. It was large and vigorous. The child died suddenly. The autopsy revealed an enlarged thymus gland and status lymphaticus. As a precaution against such unfortunate events I have

adopted as a routine measure the making of a radiograph of the child's chest so as to determine whether the thymus is of normal size. Percussion will fairly well outline the borders of the gland, but the x-ray is conclusive. If the gland is enlarged, operation should be deferred. Often one treatment of x-ray will be sufficient to reduce the gland to normal size, after which the operation may be made, usually within 6 weeks.

FIG. 230.—Radiograph of chest of child 20 months old, with an enlarged thymus gland.

I am satisfied that the mortality of children following operation upon the palate has been increased by reason of the fact that these precautions have been over looked and that children were ill at the time of operation. A surgeon who operates on a sick child cannot hope for success. I do not assume that a surgeon would so operate knowingly, but too frequently the

child is brought to the hospital by its parents who request an operation to be made at once. The surgeon often meets with opposition on the part of the parents when he insists on delay sufficiently long to enable him to know the exact physical condition of the child, but he must be firm. It is not only the question of feeding and digestion that must be considered, for

Fig. 231.—Same patient after one x-ray treatment. Thymus gland reduced to normal size.

children often contract disease on the way from their homes to the hospital. This may not be manifest on their entrance, but a day or two later develop to such an extent that an operation would be contra-indicated.

Further, the patient's history should be studied. Locally, a careful examination of the nose and throat should be made. If rhinitis or pharyngitis be found, smears should be made for laboratory examination. There

should be a complete physical examination, with family history from parents. This work done, the surgeon may proceed with an operation when the patient's condition is found satisfactory, with a greater assurance of success than would be possible if he were to disregard such preliminary examination.

Experience has taught me that the child's last feeding should be three to four hours prior to operation. The child will receive strength from the food and be better prepared for the operation. (See page 286.)

Complicating Defects.—Other congenital defects are sometimes found, a knowledge of which the parents may not have. In children who have

FIG. 232.—Author's case of cleft palate and cleft lip with deformed hands and feet. Child also had double inguinal hernia.

come under my observation, I have found the following congenital defects associated with cleft palate: Hydrocephalus, microcephalus, inguinal and umbilical hernia, club feet, a supernumerary ear, six toes on each foot and two thumbs on each hand, five fingers on the right hand and no thumb, hypospadias, web fingers and toes (Fig. 229), three deformed fingers (Fig. 232), curvature of the spine, spina bifida, absence of one eye, one eye smaller than the other, absence of the premaxillæ, cleft lip, single and double, protruding premaxillæ, one incisor tooth in premaxillæ, fissures in the cheek extending from the cleft lip to the inner canthus of the eye, angioma, phymosis, heart lesions, etc.

Patients Over Six Months of Age.—No matter what age the patient may be, it should be just as carefully examined. The condition of the stomach and bowels should be normal, the patient well nourished, the temperature normal, the pharynx free of adenoid growths and diseased tonsils. If adenoids or infected tonsils are present, no operation on the palate should be attempted until after their removal and sufficient time allowed—preferably four weeks—for the parts to have perfectly healed. In older patients, an examination of the teeth should be made, and broken down, useless roots removed, carious teeth treated and filled and chronic dentoalveolar abscesses cured. Infections from tonsils, adenoids, diseased teeth, gums and the nasal passages are not only injurious to the health of the patient, and a predisposing cause of post-operative pneumonia, but a menace to the palate operation. Pus from the nose and pharyngeal walls has often been destructive to operations on the palate. The greatest care must be observed in securing an operating field as clean as possible. The nose, mouth and pharynx should be irrigated with boric acid or normal salt solution three times a day for two days, at least, before operating. Heart, lungs, urine and blood should be examined, as the surgeon should know their condition. A colonic flushing should be given the morning of the operation to adult patients. No doubt the morning is the most desirable time for any operation, as the surgeon, rested from his work of the previous day, is in the best form to operate. The patient also has rested through the night and those old enough to give thought to the approaching operation are spared not only the hardship of fasting, but the mental distress which many experience from the hour of awakening to the moment of unconsciousness. Such distress, in nervous patients especially, is often extreme.

Operating Room.—Next in importance to the proper preparation of the patient is the operating room, the lighting of which, for surgery of the mouth, nose, trachea or esophagus, as we usually see it, is by no means satisfactory. Large sky-lights and side lights are not suitable for the lighting of the parts above mentioned. Having made use of every kind of daylight, I do not hesitate to assert that such lighting is most unsatisfactory. Neither has the use of an electric headlight, in my own experience, come up to my expectations.

Realizing that the usual lighting of the dentist's operating room was very defective, I prepared a paper on the subject of "Light."[1] Its aim was to correct the misuse of light as applied to dental operations. The notion is possessed by many practitioners of excellent repute that a large window, with a great volume of light entering it, is essential to the highest

[1] Read at a meeting of the Chicago Odontological Society, Dental Review, v. 5, p. 294, 1891.

degree in operating. I pointed out the error of such views, and that the most perfect light for operating required dark green or brown walls and ceiling which would not reflect light, but absorb it. The windows should be so shaded that rays of light will be directed upon the field of the operation. Such is the most effective light for the practice of operative dentistry. The same general principles apply to the practice of surgery. Hospital construction and modern ideas of perfect sanitation have led surgeons to cause their operating rooms to be built with enormous sky-lights, with walls painted with white enamel or made of white tile. Walls so constructed reflect light with a brilliancy second only to a mirror. The glare thus produced, with the reflection from the white linen surrounding the operator, interferes with vision and must necessarily, in the course of time, seriously injure the surgeon's eyes. It makes his work more difficult to perform and thus less efficient. The best lighting that can be secured would include the darkened walls of the operating room and all linen to be dark green or brown in color.

The Ideal Light.—The ideal light for palate operations is the electric light made up of two circles of incandescent lamps of fifty candle power, as now provided in the best equipped hospitals. The first circle should be about thirty inches in diameter and the second forty-eight inches, with a suitable reflector overhead, thus flooding the patient's face and mouth with direct rays of light. The outer circle should contain seven lights and the inner five. We not only have an abundance of bright light directed into the mouth, but the circles of light are so adjusted that the casting of shadows by the surgeon's hand while operating is impossible. All daylight should be excluded by the use of shades. The mixture of daylight and artificial light is very objectionable, as the field of operation cannot be illuminated properly. Cross lights or side lights are objectionable.

The Operating Table.—I have not found it essential to secure a special operating table. The ordinary table, as found in the better hospitals, serves every purpose. The remaining equipment should consist of a large instrument table and a smaller bracket table, one which can be suspended over the operating table. The sterilizing apparatus, etc., should be such as is found in the well equipped hospital.[1]

Assistants.—The anesthetist is of great importance and he should be so trained that he will not need the surgeon's guidance. The first assistant should also be so well trained that he will anticipate every want of the operator. He should stand at the left of the table and make use of the long forceps to pick up the sponges lying close at hand. He clears the throat and sponges the parts as frequently as may be necessary. An elec-

[1] The surgeon's example in preparation and bearing in the operating room will be regarded as the standard which is to be observed and followed by interns and nurses.

tric vacuum pump for removing saliva and blood from the throat is of great value (Fig. 398). The secretions are so well cleared from the throat that little sponging is required. He should see that all the instruments needed are sterilized and placed on the table. I might say, in passing, that this assistant should also see that the instruments are kept in perfect order. It is the surgeon's duty, when performing an operation, to be as expeditious as thoroughness will admit. To do this, he must not be required to direct the work of the anesthetist or to take the time for threading needles, handling wires, procuring sponges or any other material employed in the operation. The second assistant is really an assistant to the first, to take orders from him and aid in doing his work. These assistants may sometimes make use of the tenaculum or forceps, thus aiding in the introduction of the sutures. The surgical nurse should be thoroughly trained to perform her duties, and become familiar with the surgeon's wants. She should be constantly at hand, keeping the instruments clean, supplying the necessary sponges, threading needles and seeing that the surgeon is not delayed in his work by looking for instruments. The hands are thoroughly scrubbed with green soap and water, rinsed in alcohol and gloved.

Position of the Patient on the Table.—The patient is placed on the operating table and, by the use of straps, with suitable wristlets, carried under the body, his hands are secured firmly. In Germany, young children are put in leather wrappers and so securely fixed that their hands cannot possibly be raised to interfere with the work of the surgeon. The patient's head should be protected either by a bathing cap or a towel so that the operator's hands cannot come in contact with it. The cap also protects the hair from being soiled or covered with blood. The anesthetist sits at the head and to the left of the patient, leaving the place to the right for the surgeon. The table should be high enough to enable the operator to stand straight. A pillow should be placed under the shoulders to incline the head backward, so that the naso-pharynx is at a lower level than the larynx. Blood may then accumulate there without being inspirated. I prefer this to the Rose position. When the patient is anesthetized, the tongue should be seized with the tongue forceps (Fig. 369), lifted forward so as to render respiration easy and more satisfactorily expose the entire palate. The oral speculum (Fig. 357) should then be introduced when the field of operation is brought clearly into view.

Instruments.—After procuring all the instruments known in this country and in Europe, in the form of mouth gags with which to open the mouth and expose the parts during operation, I devised the oral speculum illustrated in Fig. 357. Fig. 360 illustrates the wire speculum which I have devised for the purpose of giving the operator a greater amount of room.

The cheek may be reflected backwards, thus exposing more fully the entire mouth. This speculum is of great value to the laryngologist. It not only depresses the tongue, but holds the mouth open and, by reflection of light, illuminates it, giving the surgeon a full view of the field of operation. I have found the long, curved, clamp forceps (Fig. 371), modified by myself, to be the best for carrying sponges and cleansing the throat. The forceps holds the sponges firmly and its curve enables the operator to carry it into the pharynx and thus cleanse it more easily. The assistants and the operator himself can pick up the sponges more quickly and satisfactorily with the forceps, use them, throw them away and pick up others than they could by dropping one sponge-laden instrument and picking up another. Sponges of gauze should be prepared in three sizes, the largest suited to sponge the throat, the medium size to keep the surfaces of the palate clean and the smallest ones to dry the borders of the fissure while the coaptation sutures are being introduced and tied. Since the introduction of the electric vacuum pump, Fig. 398, throat sponges are not so much required as formerly. By the use of this pump the mucus and blood are most satisfactorily removed. The most convenient place for the instruments during the operation is on a bracket table suspended directly over the patient. Other instruments are illustrated on p. 219.

Sutures.—The materials employed in my own operations include lead, sutures of silver wire and horsehair. These sutures do not absorb the secretions, consequently they are preferable to silk or any other fabric capable of absorbing moisture. The field of operation, by reason of the fact that we have not introduced anything that can absorb or retain secretions, is kept as nearly aseptically clean as is possible in the oral cavity. In my earlier experience, I am satisfied that infection of the parts in certain cases resulted from the use of silk and linen sutures. With frequent irrigation and non-absorbing sutures, I obtain more satisfactory results than by the use of any other material. Infection following operations now is extremely rare.

WHEN TO OPERATE

In the literature on Cleft Palate, with special reference to the most favorable time in life to perform these operations, the teachings and practices of surgeons have been, with few exceptions, opposed to operating in early infancy. As to the most desirable age for operation, Professor Kirmisson[1] stated in 1903: "Before the employment of chloroform, the operation was necessarily delayed until the child became old enough to understand the

[1] Article on Congenital Cleft Palate in Karl Deutschlander's work on Congenital Deformities.

operator's instructions. Thus Roux put the age at sixteen years; Augenback and Trelat operated at seven years. At the French Surgical Congress in 1889, Ermine reported his results of early operations. He operated upon ten children under two years of age with six good results, two deaths and two failures. Twenty children between the ages of two and six months underwent operations with seventeen good results, two deaths and one failure; lastly, eleven operations between the ages of seven and ten years, showing ten good results with one failure." These results, says Kirmisson, speak against operations in early childhood.

He further says: "J. Wolff of Berlin recommends early interference and unhesitatingly operates on children of from one to two years. I have not had an opportunity to see Wolff operate. I must confess, however, that, notwithstanding his excellent operative technic and the employment of his tampon, operating at this early age strikes me as difficult and dangerous. The field for operating is too small, the tissues thin and the sutures, therefore, easily cut through." This statement of Professor Kirmisson is an argument in favor of postponing the operation on the lip until after the bone work is finished, so as to enable us to get the benefit of extra room which the labial opening affords us. Further he says: "There exists the danger of severe hemorrhage, and, lastly, it is almost impossible to follow the operation successfully with antiseptic asepsis. Therefore, I strongly recommend operating between the fifth and sixth years."

Garretson on Early Operation.—Professor Garretson speaks[1] of the desirability of operating on young children. The reasons which he gives favoring an early operation are stated in these words: "When a child is thus, unfortunately, born and the attention of the surgeon is called to the case, it seems to me but a single question presents itself for his consideration, namely, how the deformity may be corrected. Suffered to exist, *every day will increase the difficulty of the cure*,[2] that is, so far as the most formidable part of the operation is involved, while if attempted at once, the prospect of complete success is very great. Young bone, or bone at birth, as is well known, is almost if not quite made up of animal material, while in the osseous structure of the adult, there is an excess in the limey, or unyielding material, of from 75 to, perhaps, quite 85 per cent. Let me refer to the old experiment of the maceration of bone in dilute muriatic acid to illustrate more familiarly this yielding constituent of bone. We know that if we subject a bone to the action of this acid for one or two weeks, we may tie a rib like a whip-cord. I have removed a rib from a living young cat and played with it in this same whip-cord manner. I have perceptibly bent the femur of a young child, but no one, I imagine,

[1] Text-book, Edition 1869.
[2] Italics mine.

ever performed such a manipulation on the femur of an adult. You may take an inferior maxillary bone even in the child of fifteen years, where the projection of the chin is so great as to produce deformity, and with a properly constructed vertical-mental elastic sling, you may, in a period varying from three weeks to as many years, so change the angle of the bone as to do away entirely with the deformity. You may take the projecting myrtiform border and, through the instrumentality of the occipital-alveolar plane, you may, in quite a short period, compel it to a natural articulation. On this known yielding character of young bone, therefore, operations for the correction of congenital fissures of the hard palate may be founded."

Again later in his work, we find Garretson making the following statement: "These suggestions for the cure of cleft in the hard palate were, I thought, original with myself, though it is of slight consequence who invents an operation so that it is good, but in the periscopic department of the *Dental Cosmos* I find the following extract, made by Dr. Ziegler, from the *Australian Medical Record* and *Dublin Medical Press*, which shows that the operation was conceived by another before it presented itself to my mind. The extract is a short one, and so *apropos* to the matter that I shall take the liberty to quote it entire.

"'**Pressure in the Treatment of Cleft Palate.**—I am not aware,' says the author, 'that the subject of using pressure in treating fissure of the palate has been before suggested. I am inclined to think that it has not, for when the plan first presented itself to my mind in 1851, I carefully examined French, German and American works to see whether it had. I was first led to try it on the dead body of a child which had died three weeks after birth. The fissure was longitudinal and large enough to admit the extremity of the little finger. Fissure of the lip also existed. By means of a pair of clamps, the sides of the fissure were brought readily into contact, without any fracture or displacement of the bones. The only fault was that the gums of the upper jaw were within those of the lower, but Nature would modify this as the living child grew up; the use of pressure on the lower jaw would remove a great deal of this deformity. Of course, the amount of deformity would depend on the size of the fissure in the palate. Several times I repeated the experiment on young dogs, removing a piece of palate bone by means of Hey's saw and then applying the pressure. The animals did well.

"'The operation should be performed as early as possible after birth when the bones are in their softest condition. The following is the plan which I would suggest: The edges of the fissure having been pared, the superior maxillary bone should be embraced by a horseshoe-shaped clamp with a shelf on its lower border to receive the gums and prevent its slipping.

It should be padded with india-rubber or some other material to prevent the germs of the teeth from being injured. The clamp should work on a joint and possess arms. It may be said to resemble a large pair of pincers with horseshoeshaped blades. A screw may be attached at the extremities of the handle for the purpose of bringing the blades in contact, or the hands may be used. The former would be preferable, I think, as the force could be applied gradually and not be likely to be carried too far. It may also be employed in grown-up children when the bones are so widely separated as to render it difficult to get soft parts enough to close the opening, but in a gradual manner and at intervals more or less prolonged, according to the amount of pain it excites. If it were used suddenly, it might produce inflammation and, subsequently, abscess, which would prove troublesome to treat. From the foregoing, I hope, it will be understood that *the younger the child the safer the operation is likely to prove*, and that even in grown-up children it may be adopted with precautions with decided benefit.[1]

"'The pads and the ledge to rest the teeth upon should be made to slide in the sides of the clamp; the former, that the pressure may be directed upon any part of the bone; the latter, that the edges of the teeth may rest on it without the pressure being directed either too high or too low, but at the point where the palate bone joins the superior maxillary.'"

Author's Views on Early Operation.—In 1885, having become familiar with the methods employed generally by surgeons throughout the world, and having studied the deformity from every point of view, I concluded that the time best suited to close a cleft palate was as early after birth as it was possible to operate. The basis of my belief was that a cleft might be closed by a little pressure immediately after birth, whereas, six months later, the bones would be so ossified that the moving of them together would be attended with difficulty and, besides, the results of the work would not be as satisfactory. A cleft palate is a *fissure, a separation of well-developed parts; not, with rare exceptions, the result of arrested development nor failure of the normal quantity of tissue to enter into its structure.* It is practically a wound—a cleft, surgically, like an ununited fracture. I hold, therefore, that *it should be closed in early infancy when it can be accomplished most easily with less surgical risk and with better results than at a later period in life.* Our textbooks and professors of surgery, with few exceptions, have taught that congenital cleft lip should be operated upon in early infancy and that no attempt should be made to close a cleft palate until the child is several years old. The practice and teachings of some surgeons of highest repute have led medical men, quite generally, to advise those seeking information as to the most desirable time to operate for cleft lip and cleft palate to have the lip operation performed at once and to postpone

[1] Italics mine.

the palate operation until the child is from three to ten years old. I have endeavored not only to overcome the objections raised to early operations,[1] but also to avoid difficulties with which the older surgeons contended. *After many years of study and clinical experience, I am satisfied that the most desirable time for operating upon complete cleft of the hard palate is within three months after birth. At that time we are able to secure more satisfactory results than in later life and we also avoid the objections usually raised by surgical writers. It may, however, be operated at any time.*

In the light of surgical advancement and the development of modern methods of procedure *cleft palate patients (with some exceptions), should never be permitted to attain an age when speech is attempted without having operations performed on both hard and soft palates, and the defect corrected.* Students must no longer be taught methods which should be obsolete in

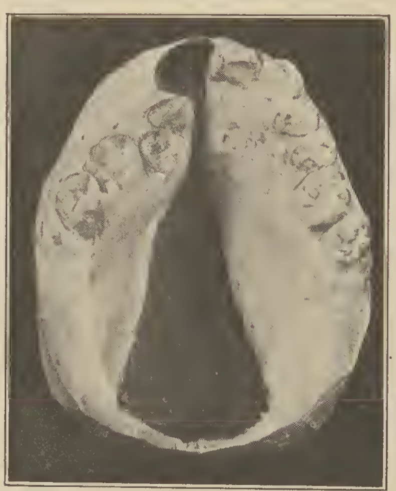


Fig. 233.—The long side protrudes beyond the short one, as it usually does, adding to the deformity. Had the edges of the cleft been freshened and correctly approximated in early infancy, a normal arch would have been produced. The condition here is not unlike an un-united fracture. The treatment should be based upon the same principles. Correct bone surgery should have been practiced early, which would have produced a normal arch, a useful palate and would have prevented this deformity.

The posterior part of the cleft has been widely separated by closing the lip and partially closing the anterior part of the cleft. The bones do not meet. If they did, they could not unite because of the intervening mucoperiosteum (see Fig. 234).

this field of surgery. The physician must not permit the deformity to remain without attention. The surgeon must qualify in modern methods in this special work as in other departments of surgery. Having, then, in mind the anatomical defects of the palate, he should seek to overcome them, *bring the abnormal anatomical parts into normality and thus establish more nearly perfect functional results.*

[1] I am glad to state that the objections which were formerly made to operating on young infants no longer prevail, and that our more progressive surgeons advocate and practice early operations.

The question of early operations has long since passed the experimental stage. I will confess that my first cases were undertaken with a great deal of hesitancy. I knew that in doing this operation in early infancy I was transgressing all the long accepted rules of surgical procedure, but it seemed to me so reasonable that the patient should be able to undergo the necessary trial that I ventured. We know that the struggle of birth is often more severe than this. There are sometimes displacements and replacements of the cranial bones during this critical natural process more radical than that of bringing into apposition the separated bones of the maxillæ. It has been the observation of every obstetrician that many injuries which the child sustains during parturition do little immediate or ultimate harm.

FIG. 234.—Illustration clearly shows the importance of bone surgery in early infancy. The nose is diverted to the left side, the nostril is abnormally wide and flat, the tuberosities of the maxillæ are broadly separated and the soft palate when united will be so short that distinct speech can be made possible only by lengthening the palate by use of the palato-pharyngeal muscles; the result of failure to unite the bones at the proper time. Compare Fig. 233.

A surgeon never hesitates as to his duty in the presence of a wound; his first impulse is to close it. Should a family with a young infant meet with an automobile accident, the mother and the child being thrown out of the car with the result to the child of a complete cleft of the lip and palate, the bones being forced apart, would the surgeon suggest postponing operative procedure for a few weeks, or a few months, or a few years? *Certainly not.* He would immediately employ means to bring the separated misplaced bones and lip into normal relations that union might take place. The same reason exists why a union of a congenital cleft of the palate should not be delayed. So a cleft palate, not unlike a wound, calls for measures which have as their

aim the closing of this wound, this fissure. A surgeon does not postpone the closing of a wound; he should not postpone the closing of a cleft palate.

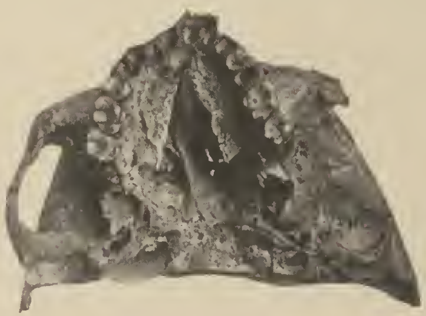


FIG. 235.—Cleft palate in an adult who evidently had lip operated. Anterior part of the cleft was approximated probably by traction of the orbicularis oris muscle, but not united. The deformity remains in the posterior part which is more widely separated. By approximation of the bones, the cleft could have been closed, resulting in a palate of normal breadth and length. Spreading of the posterior part of the cleft nearly always occurs when the anterior part only is drawn together, while the soft palate when united, remains tense like a drumhead and necessarily is too short to reach the postpharyngeal wall. Consequently, all patients thus treated have very poor phonation. The approximation of the premaxillæ here is unusually good. Author unknown.

FIG. 236.—Cast showing the premaxillæ removed, and extremely broad cleft of the palate. The distance between the buccal surfaces of the third molars is $3\frac{3}{8}$ inches. Author's case.

The literature on the subject of cleft palate clearly shows that there are surgeons who do not even contemplate or propose to close the cleft of the

bones. They cover up the great deformity by closing the lip and permit the bones to remain permanently ununited. If medical men everywhere

FIG. 237.—Lower arch equally broad. Compare with preceding figure.

FIG. 238.—Good occlusion of the teeth.

realized that palatal surgery, like other fields of surgery, has made great progress during the last quarter of a century, and if all physicians would

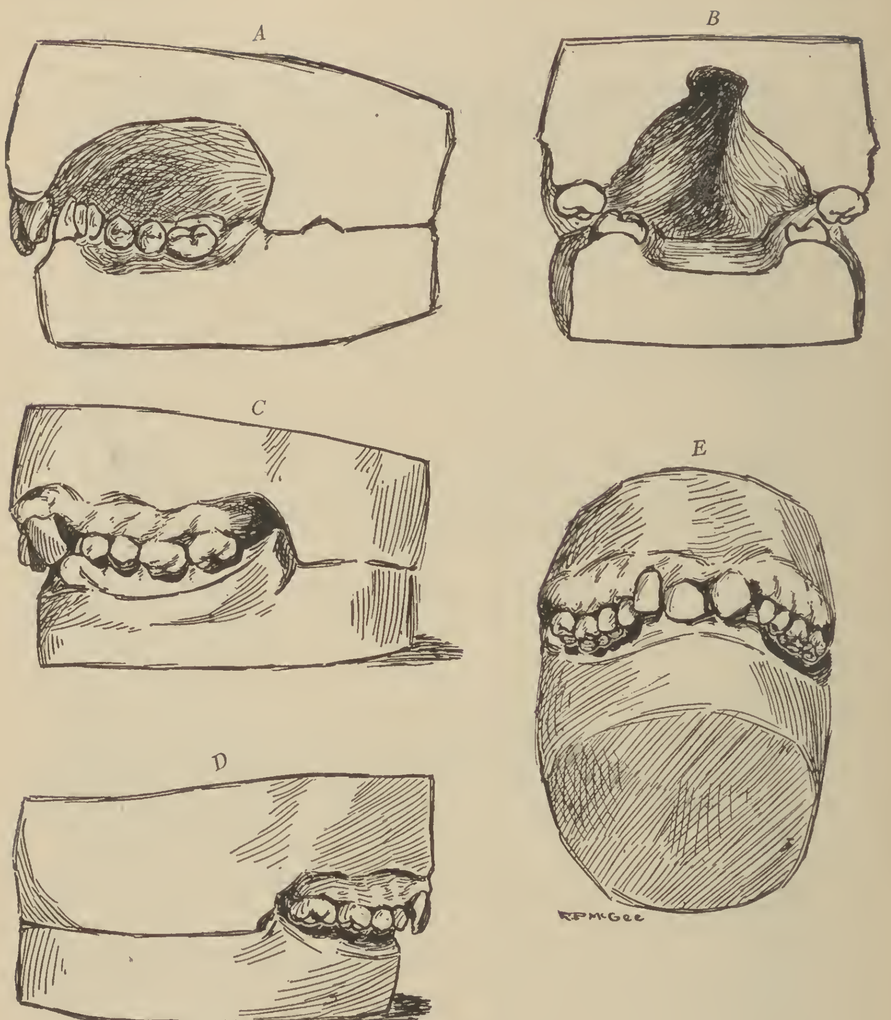


FIG. 239.—*A* and *B*, sectional drawings of plaster casts of the mouth of a boy thirteen years of age, with cleft palate, showing the overbite. *C*, *D*, and *E*, different views of the same mouth, showing the overbite of all the superior teeth when the models are articulated. It will be seen that the lower molar teeth come in contact with the mucous membrane covering the hard palate. This membrane is often penetrated by the lower teeth. Injury to the parts calls for immediate treatment. In this case, by adjusting strong bands upon the upper molar and bicuspid teeth to which jack screws were applied, the arch was narrowed but the elevation of the palatal plates was not lowered. Bands were also applied to the lower bicuspid and molar teeth to which a wire spring was adjusted to expand the lower arch. By this means the upper and lower teeth were brought into occlusion. One year later the cleft palate was closed. Author's case.

inform their patients as to modern methods in the treatment of cleft palate, every community would not include adults with this deformity

Fig. 240.—Photograph of adult's skull showing cleft of the hard palate with high arch. There is no absence of bony tissue. If the hard palate were of normal height it would be perfect. (*Photograph courtesy Dr. Binnie.*)

who have been permitted to become sufferers during life by reason of their failure to receive, in early infancy, the surgical treatment they required.

Fig. 241.—Photograph of bones of the upper jaw showing the vomer and premaxillary bones protruding. Abnormally broad arch. If the arch were moved in its proper position the cleft would be closed. (*Garretson.*)

In monographs written many years ago, I made the statement that, in some instances, palates upon which operations are delayed failed to develop for want of use of their various parts. *I have no doubt that an adult,*

growing up with a cleft palate, has not the full complement of tissue that forms a perfect palate since this tissue has failed to develop in proportion to other parts, as it has not been subjected to the uses for which it was intended. Besides, the tuberosities spread which contributes to the shortening of the palate. Hence, the importance of closing the cleft and putting the palate in use in early infancy.[1] We have observed in certain cases that, following

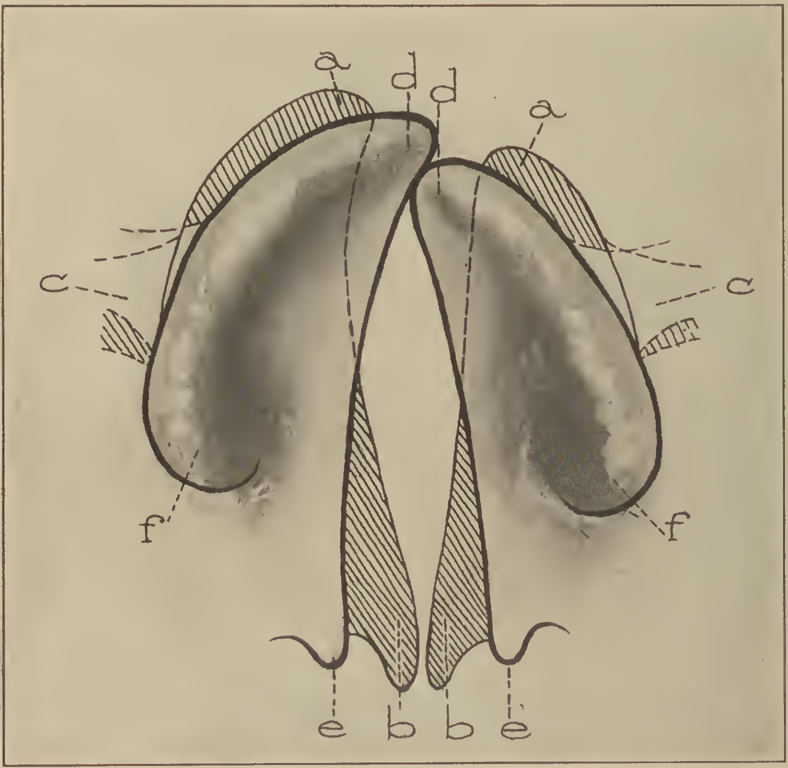


FIG. 242.—Drawing showing change in position of the palate and alveolar processes due to either contraction of the orbicularis oris muscle after the lip operation or the result of moving the anterior alveolar processes together.

a.a. Bones widely separated at birth.

b.b. Posterior part of cleft at birth.

d.d. Anterior part of cleft after alveolar processes are moved together, but not united.

e.e. Posterior part of cleft has widened. As the anterior part moves together the posterior part separates.

c.c. The malar processes, the pivots upon which the leverage is exerted to move the posterior parts outward while the anterior parts are moved inward.

f.f. The tuberosities widely separated as the result of failure to move them together or to prevent them from separating.

closure of cleft lip, the alveolar borders of the anterior extremity of the cleft, by reason of the traction of m. orbicularis oris, gradually approach

[1] See Reasons for Early Operations, p. 158.

each other and in some instances come in contact (Fig. 235) but never unite. Instead of coming in contact in a normal manner, Figs. 287 and 288, they meet but the parts are still deformed, as in Fig. 233. Furthermore, the palatal plates are carried upward and the arch elevated to the extreme. The alveolar borders of the maxillæ may be tipped toward each other, but this cannot be relied upon to close the cleft and does not correct the palatal defect nor reduce the breadth of the fissure at its distal border (Fig. 235). In fact, as the anterior borders come together, the malar bones act as pivots and the posterior portions of the alveolar proc-

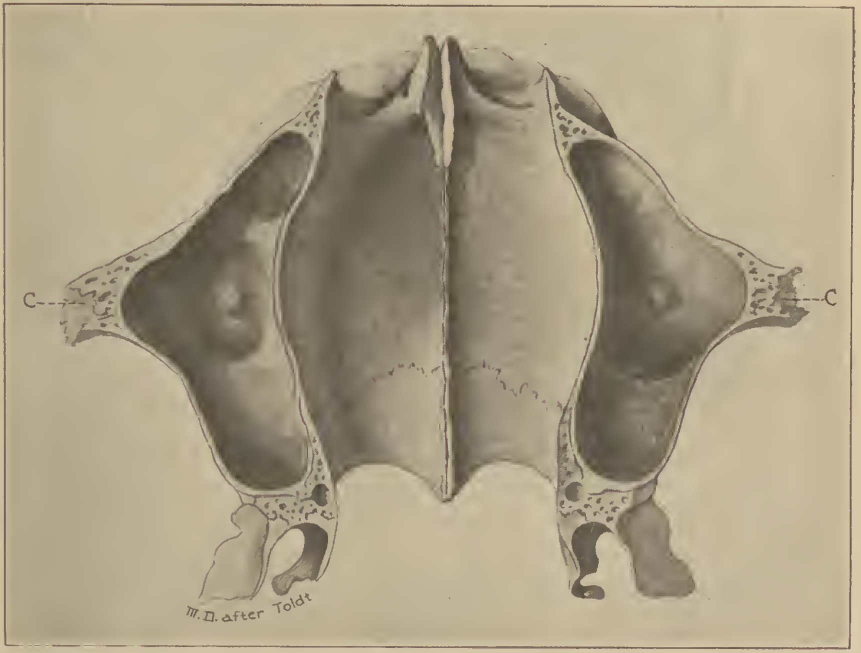


Fig. 243.—Transverse section through the malar processes, antra and vomer, exhibiting the floors of the antra and the nasal cavity. *C-c*, malar processes, the fulcra upon which the leverage is exerted to move the tuberosities farther apart while the cleft in the anterior part is narrowed. (*After Toldt.*)

esses, the tuberosities, move farther apart, and the cleft is widened (Fig. 242). Such a condition results from operations on the lip only or from wiring together the alveolar processes only in early infancy. The tuberosities should not be permitted to abnormally separate. Such a separation always shortens the palate.[1]

[1] In a recent conversation with Dr. Dean Lewis, formerly Professor of Anatomy and now Professor of Surgery in Rush Medical College, I asked him if he agreed with me regarding the spreading of the arch as I have described it in Fig. 242 His answer was, "I believe you are correct. It seems to me quite probable that the posterior parts spread if the anterior parts only are approximated, by reason of the leverage exerted with the malar processes as fulcra."

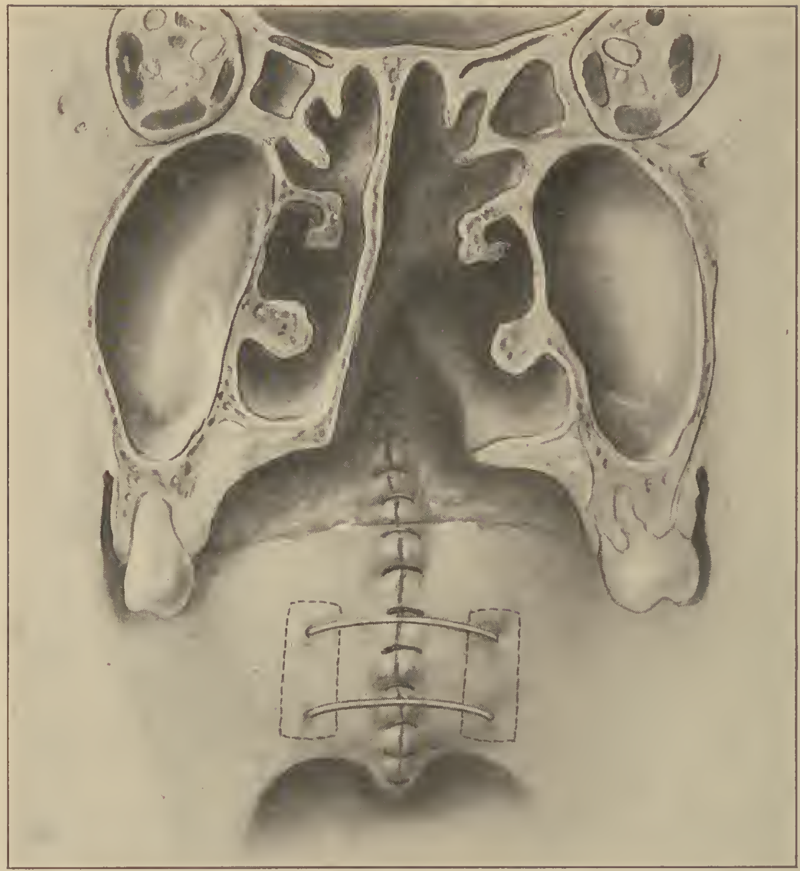


FIG. 244.—Vertical section of posterior part of hard palate showing wide separation. Dotted lines indicate position of lead plates on oral surface of soft palate.

SHOCK

In December, 1913, I sent the following personal communication to twenty-eight physicians and physiologists in the United States:

"My dear Doctor:

In operating on infants for the treatment of congenital cleft palate, my observations have led me to believe that the shock is less severe following an operation under three months of age than it would be between twelve and eighteen months.

In an article which I have written, I make this statement: 'My experience in operations performed for the closure of cleft palate at from ten days to three months of age has more and more confirmed my opinion and justified the practice. I believe in operating at as early an age as practicable after birth, usually within the first three months. My reasons are as

follows . . . The surgical shock is less because the nervous system of a young child is not well developed and it is not, therefore, capable of receiving the same impressions that it would later in life, for young children usually react better. Moreover, all mental apprehension is eliminated and we all know that alarm and dread are among the most powerful factors in producing shock.'"

The replies received were extremely interesting and, on the whole, support my contention. As will be noted, the list contains the names of those who are physicians and surgeons with wide practical experience and those who devote their time to physiology. Dr. A. J. Carlson of the University of Chicago from the physiologist's stand-point, states: "I agree with your position as regards *early* operation for cleft palate. The new-born and the very young mammal is much less affected by direct injury to the central nervous system than is the older mammal; that is to say, there is much less so-called *spinal shock* in the young. There are also good reasons for the view that the new-born is much less subject to the *surgical shock that results from trauma of afferent nerves*, owing to lower excitability of the nervous tissues. I should think that, other things being equal, the earlier the cleft is united, the less extensive and conspicuous the scar."

Dr. Winfield S. Hall writes: "We find that new-born and very young animals bear experimental operations with less shock than do older animals, also with a smaller percentage of mortality and noticeably better recovery. This experience is confirmed by my associate, Dr. R. J. Hoskins, who had the same experience with guinea-pigs in Harvard University. We, therefore, concur in the position taken in your article from which you quote."

Dr. J. A. Eyster says: "I would say that, on the theory of shock as due to long-continued inflow of abnormal sensory impulses into the central nervous system, your position in reference to operations on infants has support in experimental observation."

Another, who wishes his name withheld at the present time, pending further work, writes: "It seems that your reasoning is good and that, with proper care to conserve bodily heat, there is no reason why you should not get good results. There is another matter on which I have only a few incidental observations and that is, the rather remarkable viability of the organs of new-born mammals. I have seen respiratory movements started in a kitten after procedures which certainly long before would have definitely ended the life of a full-grown cat, and further, I have seen the heart beat long after the death of the organism. The same observation has been made on the heart of the human infant. It looks as if the new-born were provisioned for survival and that they are, in fact, much more resistant than older individuals."

It would seem, from the above remarks by physiologists, that there is some ground, from a theoretical standpoint at least, for the views I hold. In all the replies I received, no radically opposed statement has been put forth. Some have disagreed with the exact wording of the statement I made. Dr. S. J. Meltzer of the Rockefeller Institute for Medical Research, writes: "Theoretically, I would say that your view on the subject coincides to a degree with certain views I entertain personally and they are as follows: I have stated elsewhere[1] that the fundamental basis of shock is the development of *inhibition*. Now we know that the phenomena of inhibition develop very gradually in infants; they seem to be present in the first few days of the new-born. The opposite of inhibition is hyperkynesis. We know that convulsions and epileptic fits occur more often in the very young. It is, therefore, perhaps, not wholly correct to state that 'the nervous system of a young child is not well developed,' etc., as you say, but that the inhibitory mechanisms are not well developed. Of course, those who believe that shock is due to an exhaustion of the vasomotor center (Crile) or to a loss of carbon dioxide (Henderson) will have trouble to adapt their theories to your observations. But, never mind, theories are like soft clay." The main idea as expressed by me is concurred in by Dr. Meltzer.

The following are some quotations from those who have had practical experience from a surgical point of view.

Dr. G. W. Crile writes: "I am sure you are right. The neuron arcs are not completed at that time and, in a way, the operation is comparable to one under anoci-association."

Dr. T. H. Weisenburg says: " . . . certainly the surgical shock is less in a child under three months of age than in one older. Not only that, but it strikes me there is another and equally important reason: the longer a defect is allowed to remain, the greater it will become, and it should be easier to correct a developmental fault at a time near birth than a year or two later."

Dr. H. N. Moyer also concurs with the last statement.

The following is from Dr. Charles L. Dana: "I would say that your experience is in conformity with what we know of the physiology of the child. The central nervous system is not completely medullated during the period which you mention."

Dr. Howard A. Kelly writes: "It seems to me that the best judgment of the several men in the world, including your own, is all in favor of the early operation. It is better for the child in every way and there is less shock attending the operation."

[1] Arch. of Internal Medicine, Vol. 1.

Dr. James W. Putman says: "I believe you are right in your contention that it is wise to operate at as early an age as possible after birth—within the first three months—not only in cases of cleft palate, but in other conditions as well."

Dr. B. Sachs on the other hand, writes: "So far as my surgical experience goes, the younger the child the less tolerance it shows toward any surgical operation. You may eliminate the mental apprehension part altogether. It is merely a question of how much loss of blood and how much of the narcosis a young child can stand. Those are, to my mind, the chief elements in the question as applied to very young children." This physician is the only one who does not agree with me.

From all the above, I believe that I can safely state that there is no valid reason why one should wait any longer than is *absolutely* necessary to operate on children for cleft palate.[1]

Surgical Anatomy of the Soft Palate.—"The surgical anatomy of the region is to be fully understood. So much of success depends upon a thorough knowledge of the muscular relation to the cleft that such acquaintance gives success where otherwise failure would be sure to result.[2] This anatomy we may look at before taking up the steps of the operation.

To get a correct idea of the soft palate we commence to study it by first carefully examining the parts on the living subject. When we look into a mouth, we see an arch stretching from every portion of the alveolar ridge inward and backward towards the pharynx, terminating in a tongue or uvula, pendant in a vertical direction from its center. One-half of this arch is seen to be fixed, the other, the posterior half, in almost constant motion. If now the finger be called into the service, the fixed part is found to correspond with the boundaries of the palatine faces of the maxillary and palate bones, that is, for a certain extent the parts are felt to be solid as if the finger passed over an arch of bone which might be covered alone by mucous membrane, and this is, in fact, about the case. The finger traverses the anterior bony border of the mouth or the hard palate. As now the finger is passed backward, it falls over a hard ridge upon the parts that are soft and yielding; the hard ridge is the posterior face of the palate bone and terminates in the hard palate. The part upon which the finger has fallen is the veil, or soft palate, the part observed to be movable. This is the region in which occurs the rent or cleft, for the cure of which is demanded the operation about to be considered.

The mobility of this part, which pertains to its function, depends, as will be anticipated, on an associated muscular structure. To study this

[1] See under Form 7, p. 158, further discussion of reasons for early operations on bone.
[2] Garretson.

structure properly, which it is all-important to understand and appreciate practically, the student is to take up a scalpel and pass to the cadaver. It is, perhaps, only by dissecting that a really satisfactory idea of these muscles is to be secured, that is, as pertains to that kind of knowledge

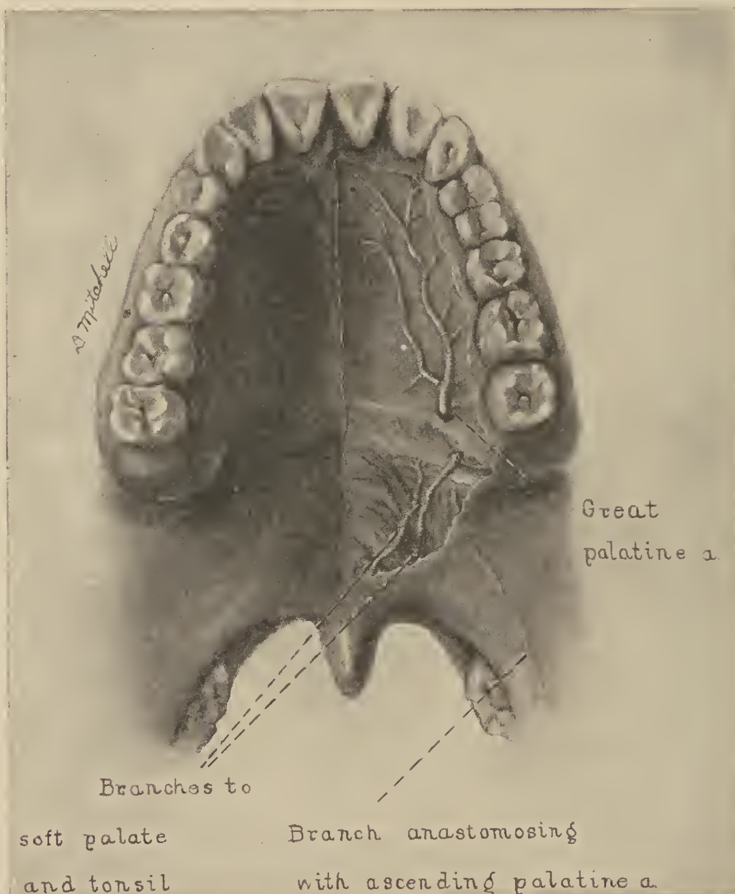


FIG. 245.—Blood supply of the palate (*New*).—Note the relationship of the great palatine artery of the alveolar process, also its branches to the soft palate. Every effort should be made to avoid injury to the artery when making relaxation incisions and when raising the mucoperiosteal flaps.[1]

which gives confidence when one comes to perform operations upon the parts.

The external coat, or covering, which is seen in every mouth, living or dead, is the mucous membrane, simply the continuation of that which covers the hard palate, but while, in the case of this part, the underlying

[1] I am indebted to Dr. Gordon B. New of the Mayo Clinic for the use of the excellent illustrations, Figs. 245 and 246. They are examples closely approaching anatomical perfection.

structure of this hard palate is found osseous, in the soft palate the deep tissue is made up exclusively of muscular substance, at least as far as surgical anatomy is concerned or as it serves the present purpose to study it.

Commencing with the mesial line, one can dissect out the attachment of five muscles, each of which is, of course, duplicated on the opposite side and each of which has such relations to a mesial line that, in case of cleft or split, it serves more or less to draw the parts postero-laterally.

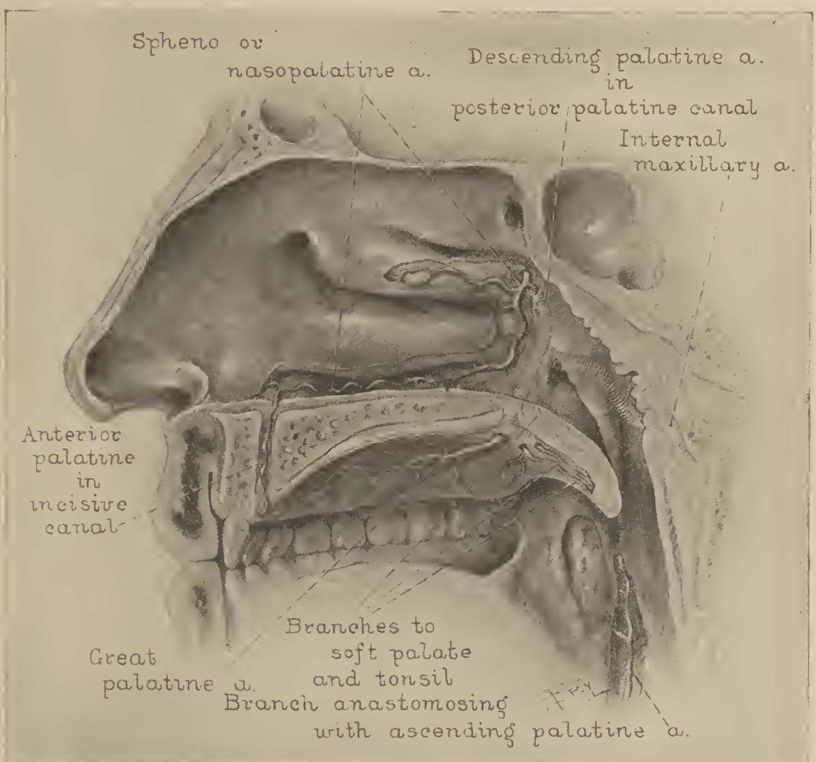


FIG. 246.—Blood supply of the palate (*New*).—Sagittal section showing the position of the anterior and posterior palatine arteries and their anastomosis.

These muscles, mentioned in the order of their significance to such lateral displacement and, consequently, in their relation to the operation of staphylorrhaphy, are the tensor palati, palato-glossus, levator palati, palato-pharyngeus and azygos uvulæ. Of all these structures the tensor palati plays the most important part and it is, therefore, entitled to the first consideration. This muscle arises from the scaphoid fossa, at the root of the internal pterygoid plate, from the anterior surface of the Eustachian tube and from the spinus process of the sphenoid bone. If the student

carry his finger in his own mouth back to the wisdom-tooth of the superior jaw and let it drop over and back of this organ, it will fall on the tuberosity of the maxillary bone; carry it about half an inch farther back and it will come to a second prominence; this is the hamular process of the pterygoid plate of the sphenoid bone. The tensor palati muscle descends from the origin of which we have just informed ourselves, and, meeting this hamular process, it winds, as a tendon, around it and then by a fan-like expansion spreads itself into the substance of the soft palate. Its action is evident: it expands the palate laterally (*and dilates the pharyngeal orifice of the Eustachian tube.*[1])

Removal of Strain.—To perform successfully the operation for cleft palate, it is, perhaps, desirable in every case that the strain upon this muscle be taken off. A moment's reflection will show that the action of the muscle in case of a cleft would, when the parts are brought together, be much increased over its natural capabilities, not only because it would be put considerably on the stretch, but also because such stretch would, more than likely, excite to spasmodic contraction. (*The practice of surgeons, as has been previously stated, has been to divide the fibers of the muscles with a view to relieving the tension or taking off the strain. The author's introduction of lead plates,*[2] *fixed with wire sutures, not only overcomes the strain, but greatly diminishes the motion of the palate and acts like a splint holding tissues in quiet contact until union of the approximated edges takes place. It is, therefore, unnecessary to divide the muscle.*[3])

Tensor Palati Muscle.—It is to be remarked that the muscle is to be found winding, as a tendon, around the hamular process. It winds from the back outwardly, inwardly and forward.

Palato-glossus Muscle.—The next most important muscle is the palato-glossus. This is simply the anterior half-arch, the constrictor isthmii faucium. It arises, as will be seen, from the soft palate on either side of the uvula, passing outward, is inserted into the sides of the tongue, blending with the stylo-glossus muscle.

Palato-pharyngeus Muscle.—The palato-pharyngeus arises from the soft palate by an expanded fasciculus and, passing outward, goes to be inserted into the posterior border of the thyroid cartilage. The two muscles constitute the posterior half arches.

Levator Palati Muscle.—The levator palati muscle arises from the petrous portion of the temporal bone, passes into the interior of the pharynx and then descends obliquely downward and inward, spreading its fibers out over the posterior surfaces of the soft palate as far as the raphé.

[1] Author's own words.

[2] Lead plates were first designed and used by the author in 1883.

[3] Author's own words.

Azygos Uvulæ Muscle.—The action of the fifth and last muscle, the azygos uvulæ, is, perhaps, not necessary to consider, its influence for separation of the wound being very trifling.

The other anatomical elements of the soft palate are glandular structures, vessels, nerves, etc., all associated, more or less intimately, by connective tissue, but these need not be particularly referred to as one could not well resect out the muscles without necessarily familiarizing himself with them. Thus, then, we understand the surgical anatomy proper of the parts, the anatomy as it has relation to the cleft palate."

EARLY CLEFT PALATE OPERATIONS

It is to the credit of the dental profession that the first operation for the closure of cleft palate was proposed in 1764 by a dentist. Inseparably associated with staphylorrhaphy is the name of the dentist La Monier, a Frenchman, who first believed that this most conspicuous and distressing deformity was amenable to successful surgical treatment, and who was the first to perform the operation. He divided the operation into four stages:

1. Paring the edges of the cleft.
2. Introduction of sutures.
3. Bringing the freshened edges together and fixing them.
4. Relieving the tension on the sutures.

Fifty-five years after La Monier proposed to close the palate by surgical methods, Roux, of Paris, in 1819 was the first to lay down and publish rules to be observed in the performance of these operations. In 1820, Warren, of Boston, without a knowledge of Roux's work, brought before the profession a similar, but somewhat modified operation, which was favorably received and adopted by many leading surgeons throughout the world. During a period of twenty-five years this operation was performed by such distinguished surgeons as Graefe, Dieffenbach, Liston, Pollock and Sir Willian Fergusson of Europe; the younger Warren, Wells, Maccauer, Stevens, Gibson, Hossack, Mutter, Pancoast and Agnew of America.

Nomenclature.—Many names are given to the operations upon the palate. Staphylorrhaphy, cionorrhaphy, palatorrhaphy, uraniscorrhaphy, staphyloplasty and uraniscoplasty are names that have been used to denote operations on the hard and soft palate. They have, however, been used interchangeably and the meanings so overlap that the terms have no fixed value.

FIG. 247.—Author's classification of forms of cleft palate.

AUTHOR'S CLEFT PALATE OPERATIONS

The author's method of operating the various forms of cleft palate follows:

Form 1.—*Cleft of the uvula muscles.* Fig. 248. This is the simplest form of cleft palate and, consequently, the most easily corrected. Many patients go through life with this defect without receiving surgical treatment with no embarrassment and without attracting attention since their phonation is usually perfect. In some cases, however, defective speech is observed. If only the uvula is involved, it may be quite as well to let it remain so, for the reasons stated. A demand is made sometimes for an operation. This should be done, preferably, at the age of sixteen to twenty months. It may be done at any age, but the suggested time is best.

FIG. 248.—Form 1. Cleft of the azygos uvula.

Surgical Technic.—The patient's head is covered and protected by a sterile cap or towel, the face, neck and mouth thoroughly sponged with an antiseptic solution, the tongue drawn forward by the use of the forceps (Fig. 369), and the oral speculum (Fig. 357) adjusted. After sponging the throat and removing mucus from the nose as well as the pharynx, the operator seizes the tip of the left half of the uvula, pulls it forward and splits its edge. The right side is treated in the same manner. Splitting this muscular tissue serves a better purpose than paring the edges, since freshened surfaces are secured sufficiently broad to unite without loss of tissue. Horse-hair sutures in small curved Hagedorn needles (Fig. 393)

are then carried by means of a Brophy-Truax needle forceps (Fig. 391) through the tip of the uvula and the ends held by forceps outside the

FIG. 249.—Manner of adjusting sutures in Form 1.

mouth. Three knots are tied in the horsehair sutures. To save time, two needle forceps should be used, the nurse adjusting the needle in one

FIG. 250.—Form 2. Cleft of the uvula, extending forward into the fibers of the levator palati and the reflected portion of the tensor palati muscles.

while the surgeon uses the other or, better, to have many needles sutured ready for use. Suturing is continued until the necessary number of interrupted sutures, usually about four, are inserted, after which they are

tied (Fig. 249) and the operation is complete. It is preferable to operate this condition before the child begins to speak—at 16 to 22 months— but regardless of the age of the patient the procedure is the same.

Form 2.—*Cleft of the uvula, extending forward into the fibers of the levator palati and the reflected portion of the tensor palati muscles* (Fig. 250). In the treatment of this form of cleft, as well as the others hereinafter described, the technic outlined in Form 1, so far as it goes, should be employed; and in those which follow supplemental measures will be used to meet the requirements in each case. In this form of cleft, the uvula is

Fig. 251.—Form 3. Cleft extending through the uvula and extending forward to the posterior border of the horizontal plates of the palate bones.

not only divided, but the fissure extends farther into the substance of the soft palate.

Also, as in Form 1, this cleft should be operated at 16 to 22 months, but whether done then or in later life, the procedure is the same.

Form 3.—*Cleft extending through uvula and forward to the posterior border of the horizontal plates of the palate bones* (Fig. 251). Before I employed silver sutures and lead plates, I experienced the same disappointments common to others inasmuch as the sutures frequently cut out and the operation was a failure. I regard the use of the lead plates and silver tension sutures essential to success in the treatment of this form of cleft. The late Professor Garretson of Philadelphia expressed the views of most authors on this subject when he said: "In looking over the history of

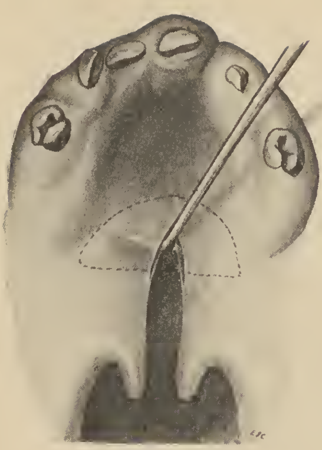


FIG. 252. FIG. 253.

FIG. 252.—Author's method of elevating and separating the muco-periosteum and aponeurosis from the hard palate or separating the soft from the hard palate at the posterior border of the horizontal plate of the palate bones (Fig. 254). This illustrates a Form 4 cleft as well as the final operation in a Form 7 cleft.

FIG. 253.—Operation completed. This is the last operation to be performed in a Form 7 palate, using the author's lead plates with silver wires, and horse-hair sutures. The lead plates must be free from sharp corners and edges and not drawn too tight, in which case they may cut the tissues.

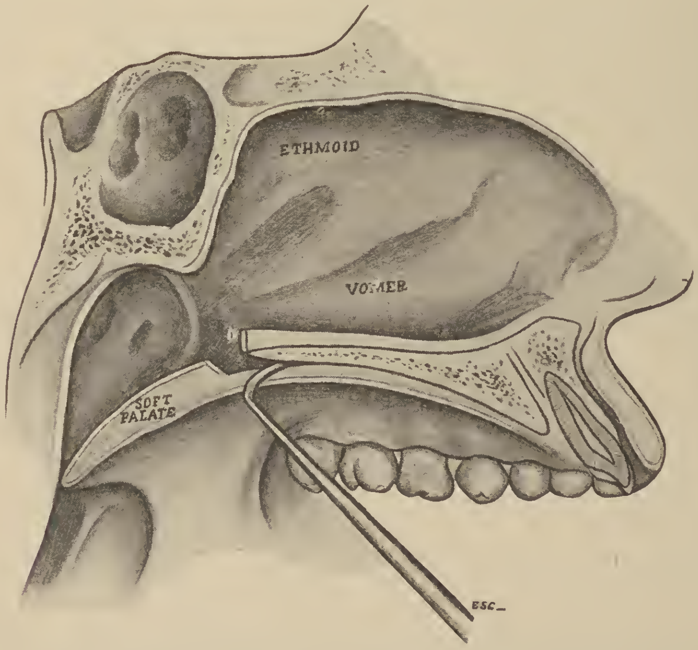


FIG. 254.—Author's method of dividing the aponeurosis or the nasal muco-periosteum from the posterior border of the horizontal plates.

staphylorrhaphy, the reader will be struck with the likeness in complaints, the three principal of which seem to be the difficulties in tying the sutures, their tendency to cut out after they are once nicely tied and the concealment of the parts during the operation, both because of deficiency of light and the accumulation of viscid mucosaliva, which, in mouths thus affected, is secreted in great abundance." Further he states: "As generally

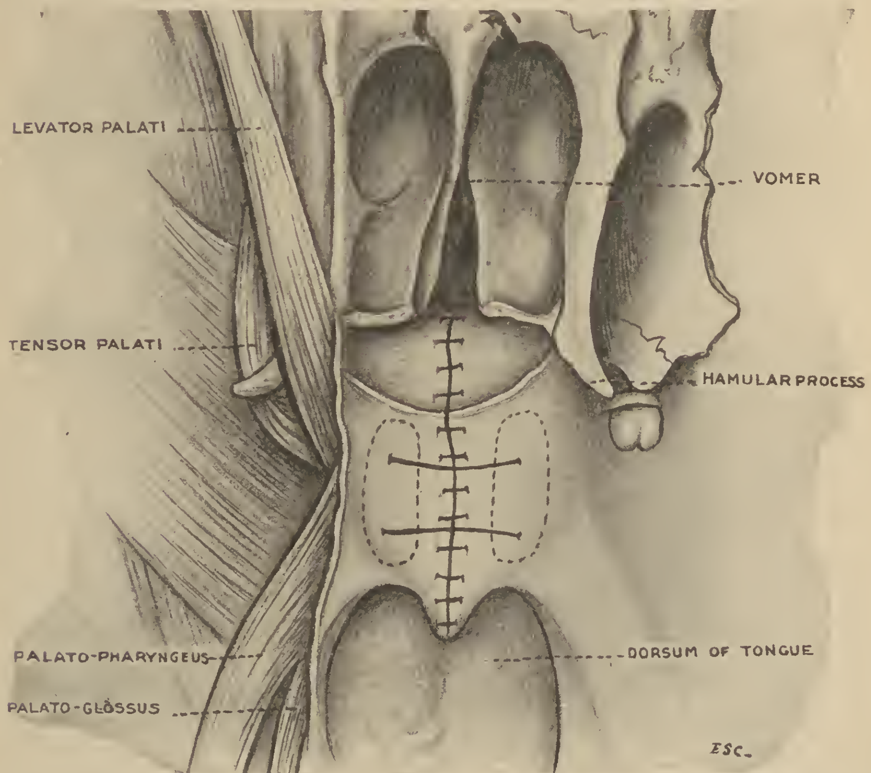


FIG. 255.—Posterior view of soft palate showing author's method of placing wire sutures. The lead plates on the anterior surface are represented by dotted lines. The wire sutures should not be placed through tissues removed from bone.

practised, it is rather difficult of performance and so frequently unsuccessful that surgeons seem disposed to avoid the responsibility of it." In addition to the complaints above enumerated, hemorrhage has been regarded as a serious complication during the operation.

The preparation of the edges of the cleft, the use of the lead plates and wire sutures are the same as hereafter described in Form. 4 If the soft parts in the anterior extremity of the fissure meet, the suturing of them may be accomplished easily. If we find them separated to such an extent that we cannot approximate the edges without first lifting the periosteum

from the palatal surfaces of the bones forward (from one-fourth to one-half inch), we make use of the periosteal elevators and lift the tissues. As in the other forms previously illustrated this cleft should be operated before speech is attempted but may be closed at any time in life, following the same surgical procedure.

The Use of Lead Plates and Wire Sutures for Approximating the Separated Maxillæ and upon the Soft Palate

Bone Operations.—I am using much heavier lead than formerly for approximating and uniting the bones in infants. No. 13, American Gauge, seems extremely heavy, but thinner lead bends too easily and is inclined to buckle over, while the heavy lead retains its form and can be made very much narrower than the thinner lead which is an advantage, since it does not extend so far up nor does it come down on a level with the alveolar border. Therefore, this heavy lead serves the purpose better.

Soft Palate Operations.—Garretson mentions the use of lead plates in soft palate work. The author was given a piece of lead by the late Dr. Cryer which was perforated with eight holes by Dr. Garretson. Cryer stated that Garretson never used lead plates in palatal surgery though he mentioned them in his writings and suggested that they might be used in some cases to advantage.

Fillebrown used lead buttons in cleft palate operations, having each button fixed separately from the others with a view to preventing the sutures from cutting out. These are illustrated in his works. But lead plates for the hard and soft palate were first used by the author.

There never has been, perhaps a greater misunderstanding regarding surgical technic than in the use of lead plates in maxillo-palatal surgery. In their use in operations upon the soft palate, they were never intended to be employed for the purpose of *pulling* the soft palate together nor in exercising great force upon the tissues. A plate upon the soft palate has a double function: First, to act as a splint and hold the freshened parts in quiet contact until they are united; and Second, to prevent the stitches from cutting out—two important uses. The area upon which a suture makes tension is only the thickness of the suture; the area upon which a lead plate makes tension is the whole length of the plate. The freshened surfaces of the fissure are thus held together. Besides, it is said the tongue makes pressure upon the newly approximated soft palate and interferes with union. The wires in the plates are so arranged that the patient will find them uncomfortable to the tongue and while the wires do not irritate, the patient will not make pressure upon them with his tongue. The con-

struction of a plate to fit over the entire palate to protect it from being disturbed by the tongue never commended itself to the author on the ground that it accumulates secretions above and becomes offensive and unsanitary.

It is well known that the older operators complained that so large a percentage of their operations failed by reason of the stitches cutting out that many of them became discouraged in their work and abandoned it. Failures resulting from the cutting out of the stitches still occur too frequently.

How should plates be made for use in the soft palate?

The illustrations in this book will show the use of plates perforated in two places and No. 22 silver wire carried through the perforations. The plate is made to rest over the tensor palati muscle. Its sharp edges are rounded and turned up a little so that they cannot cut nor bury themselves in the tissues. It is the surgeon's duty to see that they do not cut. The plates should be made somewhat boat-like so that the convex surfaces will be in contact with the tissues.

Before the coaptation sutures are adjusted, silk pilot sutures are carried through the palate as illustrated, the posterior one through the tensor palati muscle, far back from the freshened edges, and silver wires are drawn in to take their places, Fig. 256. These wires are carried back and held with forceps until all the coaptation sutures are fixed and tied. Then, having all the sutures fixed and the palate closed, the wires are passed through the holes in the lead plates which are carried into the mouth, against the lingual surfaces of the palate, and the wires tightened. The wires are twisted so that the plates will rest lightly upon the surfaces of the palate. They are placed there for the purpose of preventing the traction of the muscles from separating the newly approximated edges. They must not be too tight. The operator should examine them after they are in place and note that they are not tight enough to interfere with the circulation. If adjusted as they should be, they will serve a most useful purpose. If made too tight they will arrest the circulation in the parts.

A distinguished surgeon followed the author in operations some time ago, to learn the technic and was given all the information possible through a series of operations, and shortly afterward he made the operation. He wrote the author that following operation, all the tissue sloughed. He wanted to know how this could be accounted for, which was not difficult, since he had drawn the wires too tight and made pressure upon the palate so that the circulation was cut off and the tissues were lost. No doubt this accident has befallen others, because they were not well informed as to how to make use of this valuable adjunct to palatal surgery.

Removal of Sutures.—The lead plates and horsehair sutures may remain in place for ten days, when the plates and all sutures may be taken

out. To remove the plates, one of them, with the overlying wire, is seized by forceps, lifted away from the tissues a little and the wires cut under the plate. If cut next the twist of the wire, a little hook will be left which will lacerate the tissues when withdrawn with the removal of the opposite plate. Next, seize the opposite plate with forceps. By turning it toward the center of the palate, the plate and wires will come away.

Silver wire as supplied by the dealers is usually stiff, hard to twist and likely to break. To make it dependable it must be annealed and made soft and flexible. The coils of wire should be loosened, placed in a

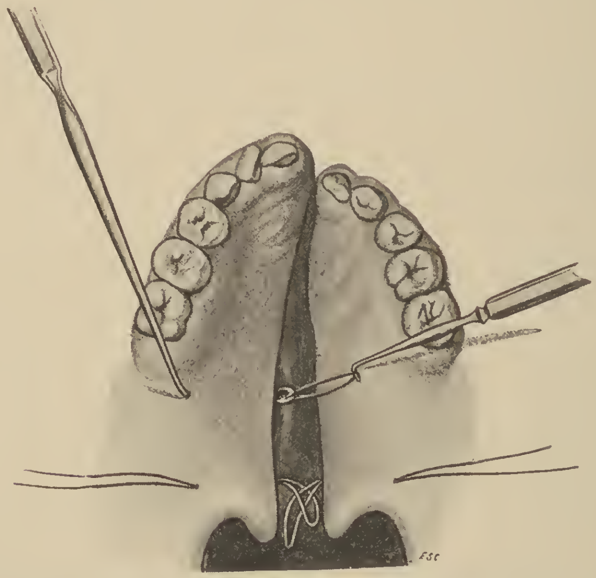


FIG. 256.—Method of introducing silk pilot sutures in soft palate operations. This precedes the introduction of the silver wires.

dentist's porcelain furnace, heated to a cherry red, removed and allowed to cool. Silver wire so treated is soft, can be twisted without fracture or even tied in a knot.

Form 4.—*Cleft extending through the entire soft palate, including partial or complete cleft of the horizontal plates of the palate bones* (Fig. 257). We meet in this form of cleft a condition calling for steps not usually necessary in the preceding forms. Here we use instruments to denude the bone of the muco-periosteum along the borders of the cleft and a little way forward of the anterior extremity of the fissure. The first step is to use the curved periosteotomes (Fig. 368). I designed these instruments of different sizes and angles to meet the requirements of individual cases. The instrument should be carried back into the cleft and above the soft palate, brought in contact with the distal border of the horizontal plates of the palate bones

and the muco-periosteum divided (Figs. 252 and 253). The instrument is then carried forward along the entire length of the border of the cleft and the periosteum removed on both sides of the fissure. If little flakes of the bone are removed with the periosteum, its osteo-genetic properties develop new bone where needed. By lowering these tissues from the hard palate, the U-shaped anterior extremity of the cleft (Fig. 262) will be converted into the form of the letter V (Fig. 263). We are now able to bring the edges of the cleft into contact throughout its entire length. It will be observed that by removing the periosteum from the borders of the fissure and dividing it above the velum and at the posterior border of the horizontal plates of the palate bones, the operator is not only able to bring

Fig. 257.—Form 4. Cleft extending through the entire soft palate, including partial or complete cleft of the horizontal plates of the palate bones.

the edges of the cleft easily into contact, but he *lowers the vault of the palate and, at the same time, lengthens it so that it more nearly or quite approaches the posterior pharyngeal wall.*

The edges of the tissues should be split from the tip of the uvula to the anterior extremity of the cleft, care being taken that the splitting is done in such a way that the freshened surface will approach the opposite side after it has been treated in the same manner. The incision should be carried through the mucous membrane and into the muscular tissue. By retraction of the mucosa, a freshened surface, sufficiently wide to secure union of the parts after they are approximated, is obtained. Should folds of the mucous membrane along the freshened surfaces seem

likely to prevent contact, they should be removed. After the edges of the cleft are well freshened, a properly formed needle (Deschamp's, Fig. 374), curved after the fashion of a gynecologist's needle, is employed and silk pilot sutures introduced through the tissues about midway between the border of the fissure and the alveolar process. With the long clamp forceps or tenaculum, the stitch is picked up and the needle is withdrawn. The silk sutures are substituted by No. 22 silver wire, then the lead plates, No. 20 American gauge of suitable length and width, are perforated with holes corresponding to the number of sutures to be placed and shaped so as to extend from near the distal border of the soft palate forward three-fourths of the length of the fissure. The lead should be bent to conform to the shape of the palate. The wire sutures are then passed through the holes in the lead plates, adjusted to the palate and twisted together. Two

FIG. 258.—Ferguson's method of treatment when the muco-periosteum is thin.

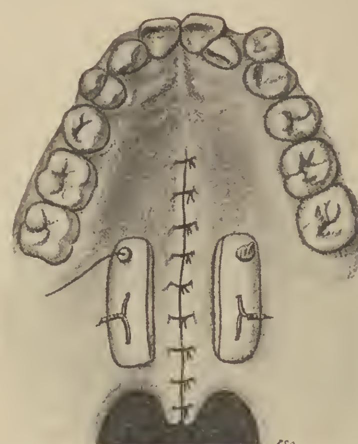


FIG. 259.—Fixing the third wire (one without a mate) with lead shot with a hole through it.

sutures are required in this form of cleft. Before the lead plates are fixed in place, as a matter of convenience, coaptation sutures of horse-hair should be introduced and tied, after which the lead plates are adjusted. The mistake must not be made of tightening the wires so as to interfere with circulation of the parts.

It has been observed by all operators that the muco-periosteum covering the hard palate is, in some cases, exceedingly thin at the posterior border of the horizontal plates of the palate bones. In other words, there is very little connective tissue intervening the periosteum and the mucous membrane. The muco-periosteum and intervening tissue is always much thinner than the soft palate. It is important, therefore, to avoid passing the needle through this thin portion. It should be passed posterior to it (Fig. 255). This precaution must be observed since the tension of the sutures on this

thin tissue may lacerate it and leave an opening which will require subsequent operation to close. To thicken these tissues the late Alexander Hugh Ferguson practised a line of treatment preliminary to operation which is as follows;

He made use of a sharp pointed steel instrument and under local anesthesia perforated the soft parts covering the hard palate. These perforations should be repeated from time to time during a period of three months. The connective tissues then become much thicker (Fig. 258). It is very apparent that thicker surfaces will unite more readily and make a stronger, and more substantial palate. My experience convinces me that Dr. Ferguson was correct.

FIG. 260.—Form 5. Cleft of the entire soft palate, extending through the horizontal plates of the palate bones and into the palatal processes of the maxillæ.

The number of wire sutures used to fix the lead plates in this form of cleft is usually two; sometimes three or even four in adult cases of extreme length. Should three sutures be used, the mates are to be twisted together, while the one without a mate should be fixed by means of perforated shot (Fig. 259).

Form 5.—*Cleft of the entire soft palate, extending through the horizontal plates of the palate bones and into the palatal processes of the maxillary bones* (Fig. 260).

The treatment of this form does not differ materially from *Form* 4. It consists in elevating the muco-periosteum in the same manner, but the bone is denuded further forward than is called for in *Form* 4. Two wire sutures

are almost invariably employed. As in the other forms, the borders of the cleft must be freshened throughout the entire length.

FIG. 261.—Form 6. Cleft of the entire soft and hard palates nearly as far forward as the line of union between the palatal plates of the maxillæ and the premaxillæ. In Forms 5 and 6 the palatal plates are in part sometimes deficient, but more frequently the arch is unusually high, the bones forming the hard palate are elevated by the tongue in embryonal life and the space therefore gives the appearance of absence of bone.

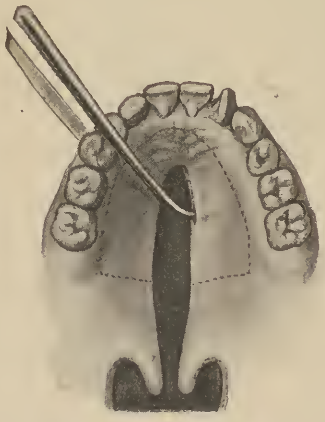


FIG. 262.

FIG. 263.

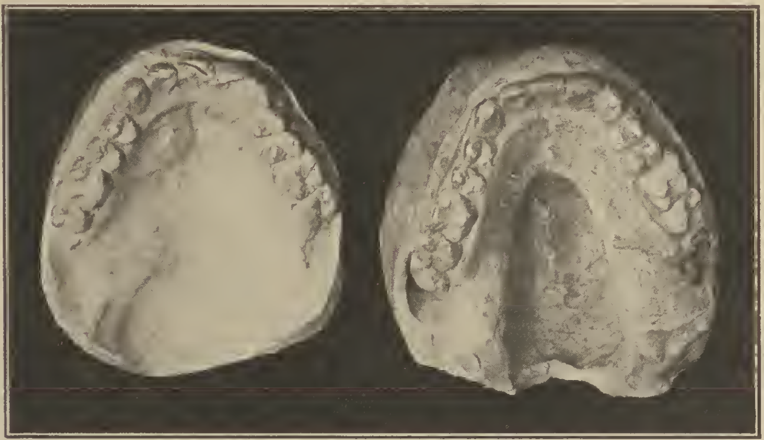
FIGS. 262 and 263.—The author's method of changing a U-shaped cleft into a V by the use of the periosteal elevator.

As in the previous forms, while the operation is preferably done just before speech is attempted it may be done at any time later, and the procedure is identical.

Form 6.—*Cleft of the soft palate nearly as far forward as the line of union between the maxillæ and the premaxillæ* (Fig. 261).

Fig. 264.—This picture clearly shows the result obtained by the author's method of operating cleft palates in adults. The two lead plates are seen just to the inner side of the teeth. The line of horse-hair sutures is clearly shown. No tension is placed on them.

In this form it is necessary to use the curved periosteotome and to denude the hard palate of the periosteum from the borders of the cleft to



B *A*

Fig. 265.—Plaster casts before (*A*), and after operating (*B*). A good palate was obtained for this girl without lateral incisions. Form 6 cleft.

the alveolar processes. This converts the U-shaped fissure to a V (Figs. 262 and 263) and allows the edges to come together, after which plates of lead and silver sutures are used as in other forms (Fig. 259).

AUTHOR'S OPERATION IN EARLY INFANCY (FORMS 7 TO 14)

Experience in employing my operation for the early closure of cleft palate has more and more confirmed my opinion and justified the practice. I am firm in my belief that the *bone operation* should be done as early as practicable after birth, preferably within the first two months. Up to the age of five months the bones may be easily approximated. Beyond the age of six months the process of ossification is so far advanced and the bones are so dense that bending and moving them into contact is difficult. The wire sutures and lead plates may be used, however, and the bones moved together by tightening the wires from time to time (page 195). The soft palate should not be operated until the age of sixteen to twenty-two months. The reason for delaying is that the muco-periosteum

FIG. 266.—Congenital cleft palate with retrusion of the mandible.

removed from the bone is frail and likely to break down. If the child is operated before he speaks, articulation will be correct.

The operation on the bones, when complicated with cleft lip, single or double, should be made before the operation on the lip. To treat a cleft palate when the bones are completely separated, and follow a course leading to a more nearly normal condition than can be reached by any other method, the order of procedure is as follows:

1st, *Bone surgery.* The bones are freshened, approximated, and firmly immobilized, so that union may take place.

2nd, The lip is closed, in six weeks or later.

3rd, The soft palate is closed at the age of sixteen to twenty-two months.

FIG. 267.

FIG. 268.

FIG. 267.—A child of four weeks, exhibiting a complete cleft of the hard and soft palate, with cleft lip on the left side. The nose is diverted to the right side and on a line with the right angle of the mouth. It will be observed that the nostril is very broad and flattened. This typifies the most common form of cleft palate. As usual, we find the anterior part of the cleft is very much broader than the posterior.

FIG. 268.—Same child, with the separated bones closed and the nose put in the median line of the face. Without any effort to correct it, the nostril has already, by reason of the closure of the palate, assumed a much better form.

FIG. 269.

FIG. 270.

FIG. 269.—Photo of same child, taken on the same day as Fig. 268, showing front view.

FIG. 270.—Same child at the age of five months, after lip operation was made. This child was operated upon in proper sequence—first, the bones; then the lip; and at the age of sixteen to eighteen months, the soft palate will be closed. As before stated, by proceeding in this way we will more nearly than by any other method secure a condition closely approaching normality.

Operations should be made in early infancy for the following reasons and in the order named:

1. The approximation of the separated bones is an operation of the greatest importance. It is essential that it precede the operation on the lip and nose so as to establish normal facial contour and to prevent the tuberosities of the maxillæ from abnormally separating. The widely separated tuberosities prevent the production of a soft palate sufficiently long to reach the posterior wall of the pharynx, consequently normal speech is impossible unless the palate is made longer by making use of the palato-pharyngeal muscles.

FIG. 271.—A study of the growth of the palate from infant to adolescence. The cross on both palates is the same size, 18 mm. in length and 20 mm. in width, which are the full dimensions of the infantile palate. The measurements on the infantile palate were taken from the anterior palatine canal to the posterior nasal spine, and between the posterior palatine canal. When the cross of the same dimensions is laid on the adult palate, taking the anterior palatine canal as the fixed point, it will be seen that the cross piece is at the level of the posterior borders of the second bicuspids, which is the original position of the posterior palatine canals, and while there is a slight lateral and forward growth of the palate, the great part has been backward which was to be expected because it corresponds to the direction of growth of the alveoli of the upper and lower jaws. (*Blair.*)

The fissure in the lip enables the operator to gain more room in which to work.

2. The nose of a patient having single cleft lip and complete cleft palate, if the bones are not united remains diverted from the median line towards the side opposite the fissure. It is carried with the long side of the bone, which protrudes somewhat, away from the center of the face (Fig. 267). Thus early operation straightens the nose at once and brings it into the median line (Fig. 268).
3. The cleft should preferably be closed before ossification of the bones is far advanced, while they may be bent or moved without fracture. Bone at birth is about one-half organic matter, hence it is not difficult to bend the bones and close the cleft a few weeks after birth (Figs. 275 and 276).

4. The tissues unite kindly and the surgical shock following the operation is not so great if it is performed within the first few months as it would be later in childhood. It is a well established physiological fact that the

FIG. 272.—Casts of a case before and after the operation of approximating one maxilla with the maxilla and intermaxillary part on the other side of the cleft. The picture to the left presents the condition before operation, that to the right after operation. The dotted line across part of the first picture shows the width of the palate after operation and demonstrates that the palate was narrowed by nearly one-third of its greatest width. The apparent discrepancy in the size of the maxillary bones in the two pictures is due to the fact that in the position in which they are seen before operation a greater bulk of the jaws is turned broad side to the camera than appears after operation. The exact cross measurements on the casts are 36 mm. before operation as against 27 mm. after operation. (*Blair, in The Dental Era.*)

nervous system of a child is not so well developed in early infancy as it is later. Therefore, young children usually react better, and this is one of the advantages of performing this operation before the nervous system

FIG. 273.—A cleft of the palate with cleft lip on left side (Form 7). The nose is diverted to the right.

FIG. 274.—Same patient one hour later with hard palate closed. Nose brought to the median line.

has developed to a point which would subject the child to a more severe shock. Moreover, mental apprehension is eliminated and we all know that alarm and dread are among the most powerful factors in producing shock (see page 134).

5. The operation in early infancy brings into action the muscles of the palate. These, therefore, develop instead of becoming atrophied for

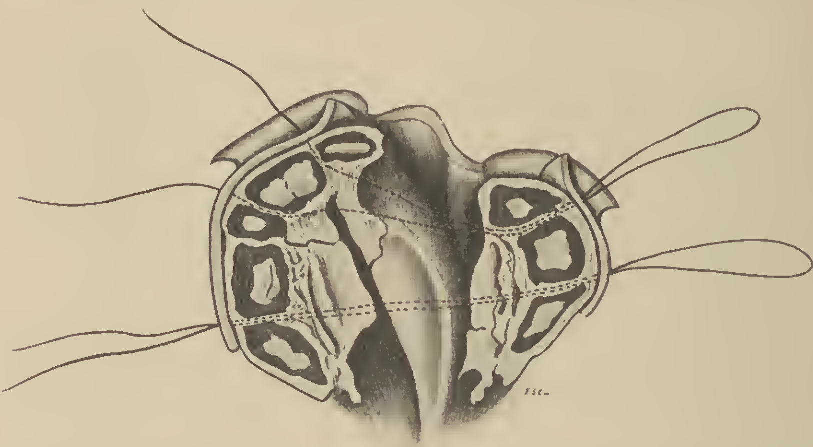


FIG. 275.—The extremely wide fissure is closed by passing the author's wire sutures between the teeth and through the bone. Lead plates through which the wire sutures are passed are used to prevent the wires from cutting when pressure is made to bring the edges of the cleft in contact. (*After Keith.*)

want of use. Hence a good velum is secured, with plenty of tissue, whereas, if the operation is delayed until later in life, the tuber-

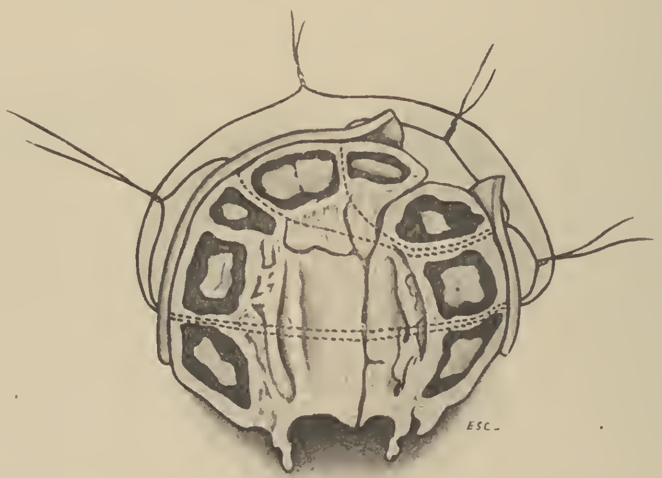


FIG. 276.—Fissure closed. Normality established. The bones have been bent into correct position. (*After Keith.*)

osities of the maxillæ spread and the muscles cannot as surely be made to subserve the same purpose as tissues which develop through natural employment. It is well known that muscular tissue is more

perfectly developed through action. The muscles of a cleft palate are not normally employed. By operating at an early age, the muscles are at once brought into use and their development is proportional to other tissues.

6. Following early operation, there is much less deformity, for all the tissues, bony as well as soft, are brought into normal relations and develop naturally and according to accepted types. When the operation is postponed a few years, it is very difficult to secure such results.
7. When the palatal processes of the maxillæ are united, it will be observed that the development of the bones and the alveolar processes of the maxillæ assume a form nearly or quite normal and when the teeth are erupted they will occlude properly with the lower ones.
8. *The most important reason for making the early operation is that when made in early infancy, first, on the cleft hard palate, second, on the lip, and, third, on the soft palate, a normal condition is established which enables the patient to speak as children do who were born without this congenital defect.*[1]

In all patients there are irregularities of the incisor teeth joining the cleft alveolar process. This condition exists whether the individual is operated or not (Fig. 277).

It was predicted that, as the result of my operation, the upper jaw would be contracted and be made much narrower than the lower one, and that it must always remain contracted; also, when the teeth in the upper jaw were erupted, they would be considerably within the arch of the lower ones. My answer was that later a skilled orthodontist would be able to spread the arch and correct the irregularities. I must confess that I was operating for five years before I was impressed with what had proven a fact, that a cleft palate is a spreading of the upper jaw and velum and is not due to arrested development nor to an incomplete development of tissue which enters into its structure. Like many practitioners, I was willing to accept the teachings of others without venturing to investigate and endeavor to solve the problem, which, through the centuries, had been misunderstood and erroneously taught.

Before discovering that the deformity consisted in failure of union and spreading of the arch, I worked without being able to state, from an anatomical point of view, why I moved those separated parts together. Surgeons of good repute, clinging to the old theory and, in some instances, to the teaching of their own books, declared that my operation was inexpedient and without precedent; that it would cause nasal stenosis and, by abnormally contracting the jaw, produce a worse deformity than the one I was attempting to overcome. It is now recognized and admitted by sur-

[1] See Author's View on Early Operations, p. 125.

geons familiar with my technic and results that my operation, more than any other, *establishes the normal anatomical condition.*

In a personal communication from Dr. Vilray Papin Blair of St. Louis, he states: "It seems to me that the matter under discussion resolves itself simply to this: a nasal obstruction certainly is a great detriment, especially to a very young infant or animal, but, in approximating the jaws in cleft palate, there is no necessity of causing an obstruction. This can readily be proved by the illustration in my book showing the extent of the spreading of

Fig. 277.—The incisor teeth are always irregular in complete cleft palate whether operated or not.

jaws in cleft palate (Fig. 213). Further, I do not see how one may well take the position that it is improper to approximate these spread jaws in an infant by your operation and yet be advisable to approximate them at the age of two years by orthodontic apparatus. The procedures are essentially the same and it is just a question whether you will do it at two weeks or two years."

In the teachings and operations of Sir Arbuthnot Lane of London, whose methods are hereinafter described, I find support in the position I have taken (that cleft palate operations should be made in early infancy). Lane thoroughly described his operation in 1902.[1] His work has extended over a period of many years and his studies of the abnormalities of the

[1] London Lancet, February, 1902.

palate and their sequelæ form one of the most valuable contributions to the literature of the subject. The anatomy and physiology of the parts in question have been dwelt upon at great length. The muscles associated with a congenital defect adapt themselves to the abnormal condition. This is observed in the muscles of the pharynx in cleft palate patients. These muscles by reason of the uses in excess of their function to which they have been put are much larger, thicker and stronger than in persons whose palates are normal.

FIG. 278.—Form 7. Complete single cleft of the entire soft and hard palates including the alveolar process. The maxilla is separated from the premaxilla, usually on the left side and accompanied by single cleft lip.

Lane has pointed out and agreed with me in this, that persons thus afflicted, though otherwise normal, do not usually develop as vigorously as those free from the defect. A cleft palate patient, as a rule, suffers from chronic pharyngitis, hypertrophied tonsils and adenoid growths.

AUTHOR'S PROCEDURE FOR BONE OPERATIONS[1]

My method of procedure in operating for closure of complete cleft palate in children under six months of age is as follows: The patient should be prepared as previously described. No speculum or gag is necessary in this operation since the patient is without teeth and the mouth is easily held open by the fingers. The technic is the same whether the cleft is on right or left side. Here we deal with the left side. The plate with three holes is always used on the long side.

[1] The procedure for treatment of this form of cleft in adults will be found on p. 205.

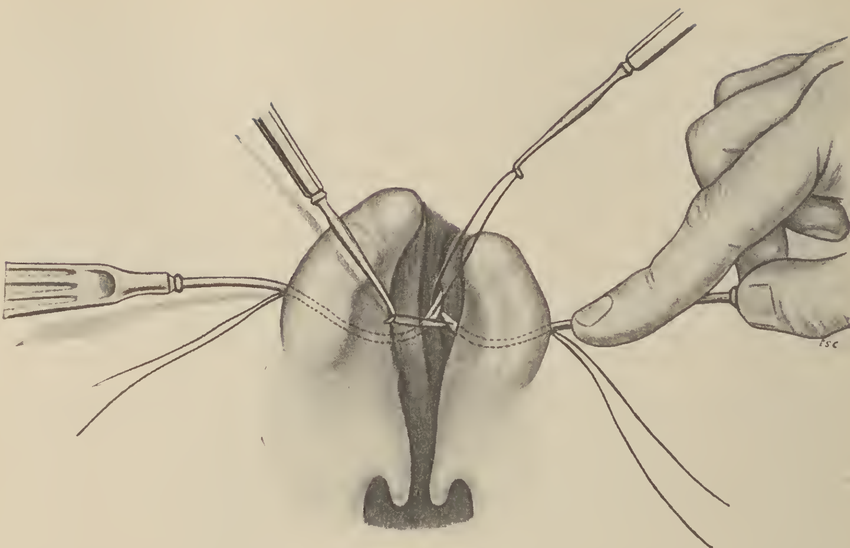


Fig. 279.—Method of introducing the pilot sutures in hard palate operations. The curved needles illustrated, I have found very useful, but the straight needle shown in Fig. 280 is more easily inserted, makes a smaller opening through the bones and the operator is never in doubt as to the position of the point of the needle.

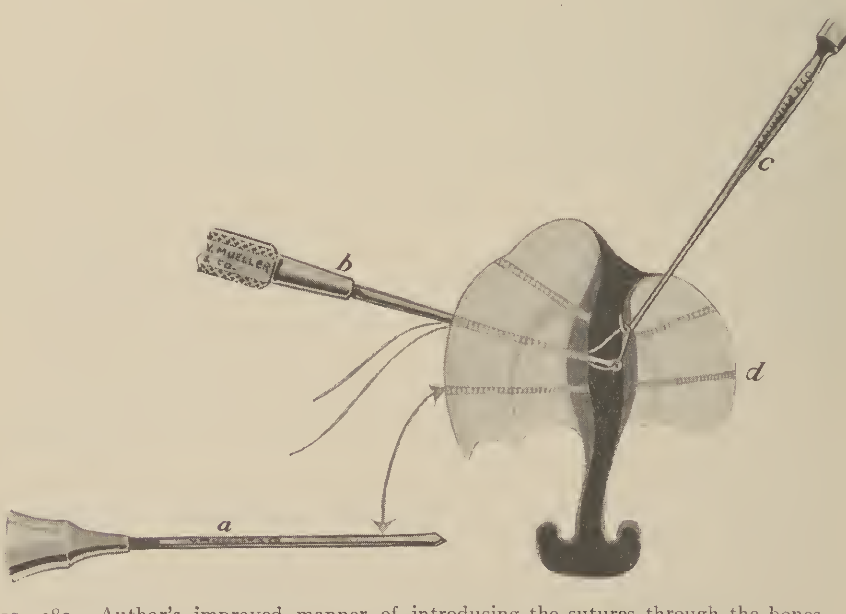


Fig. 280.—Author's improved manner of introducing the sutures through the bones. Drill; *b*, new straight needle; *c*, tenaculum; *d*, opening made by drill.[1]

After the patient is anesthetized, raise the right cheek high and insert the needle or drill[1] (Figs. 378 and 379) through the substance of the right maxilla just behind the malar process. In the hands of the inexperienced, the

FIG. 281.—Dissection of upper and lower jaws, exposing the unerupted teeth. The photograph of this cadaver shows the external alveolar plate removed. The position of the teeth and the ease with which a well directed needle or drill may be carried between them so as not to disturb them, may be noted. In passing the needle or drill it should be so used that the flat side will slip in between the teeth. In penetrating the tissues, the expert hand will easily detect the difference between tooth and bone. When the instrument comes in contact with the tooth it should be directed first forward and then backward until it slides between the teeth and passes through the tissues. (*Special dissection by Dr. H. E. Radasch.*)

straight instrument is safer as the operator can easily pass it between the teeth without disturbing them. He must, however, be able to detect a

[1] The small drill is used for the purpose of making a hole through the bone. This instrument, when carried through the overlying soft parts into the bone may come in contact with a tooth. If so, the instrument may be moved backward or forward until it passes between the teeth and then through to the center of the cleft. It is then withdrawn and the needle, armed with a stout silk suture follows the track of the drill and the suture is picked up as shown (Fig. 280). Those who are not largely experienced in the use of the straight needle will appreciate its simplicity and utility. The dotted lines on the model indicate the openings in the bones through which the needle passes. The new needle is shaped like a probe, with eye in the point. It easily follows the opening made by the drill. Observe that the needle point makes its exit in the cleft.

tooth when the instrument comes in contact with it and also to change the course of the drill, so that he passes it between the teeth. Immediately after withdrawing the drill, a needle with the eye in the point threaded with a heavy braided double silk suture, is carried through the hole made by the drill (Fig. 280). The needle carries the pilot suture; which is removed as shown in Fig. 280. The needle should enter the tissues at the fold of the mucosa or a little above and should be carried *over the hard palate* to the center of the cleft, where its point will be seen (Fig. 279). The needle should be introduced so that it will pass between the teeth

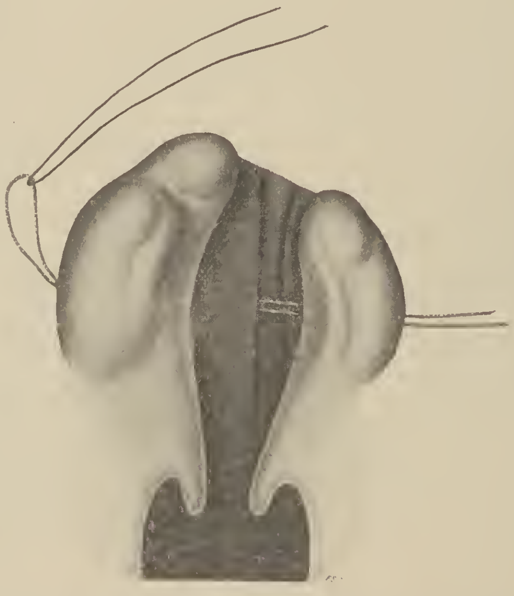


FIG. 282.—Pilot suture of silk has been introduced and silver wire is shown passed through the loop traction on the silk, the silver wire is drawn into place. After this the loop in the silver is cut, thus giving two sutures.

which are easily located by the touch of the point of the needle (Fig. 281). The suture is seized by the tenaculum and the loop end drawn out of the mouth while the needle is also removed. We have now a double suture through the right maxilla with the loop end in the center of the cleft. A corresponding suture is carried through the left bone. We then have two silk suture loops carried through the bones to the center of the cleft, and, by passing the left loop through the right and making traction on the latter, we carry the left loop through both maxillæ (Fig. 282). Nearer the front portion of the right maxilla, insert another double suture, in the manner already described, with which to carry the second loop to be inserted in a corresponding position in the left maxilla. The left loop is carried by

means of the right loop through the right bone (Fig. 283). We now have two loops extending through both bones and with these we carry the double silver wires into place.

Still nearer the anterior part of the right maxilla, the long part, we insert another pilot suture. The needle or drill should pass between the positions to be occupied by the right central and lateral incisor teeth. This is followed by the needle carrying the silk pilot suture. The silver

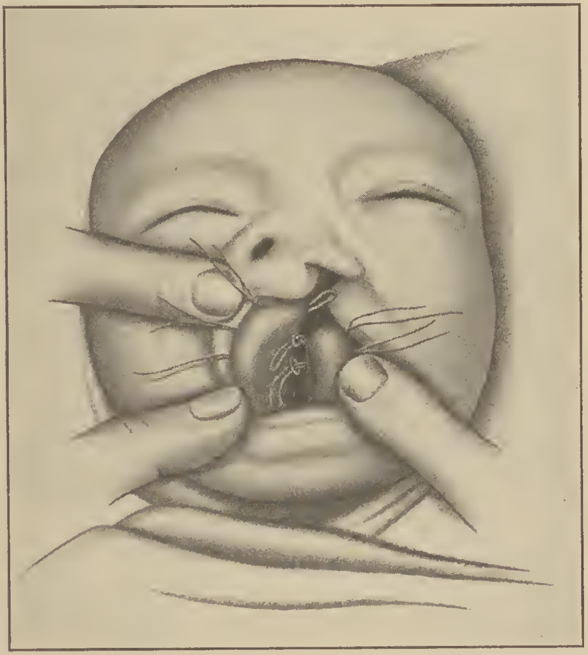


Fig. 283.—Pilot silk sutures all inserted.

wire is then inserted (Figs. 284 and 285). One of the double anterior wires, which passes through the bone, is drawn back to the center and out of the right bone. This wire is fixed to the anterior loop last inserted and drawn through the bone (Fig. 285). *The double strands of No. 20 gauge wire are now passed through the maxillæ above the hard palate so as to come out in the fissure. Serious errors have been made by omitting this precaution.* The loops are cut at the ends making four single strands. These wires are larger than those used in the soft palate as they must be stronger.

The next step is to make lead plates—No. 13 American gauge to fit the convexity of the buccal surfaces of the bones. These should be smooth, the sharp corners removed and they should be perforated with holes

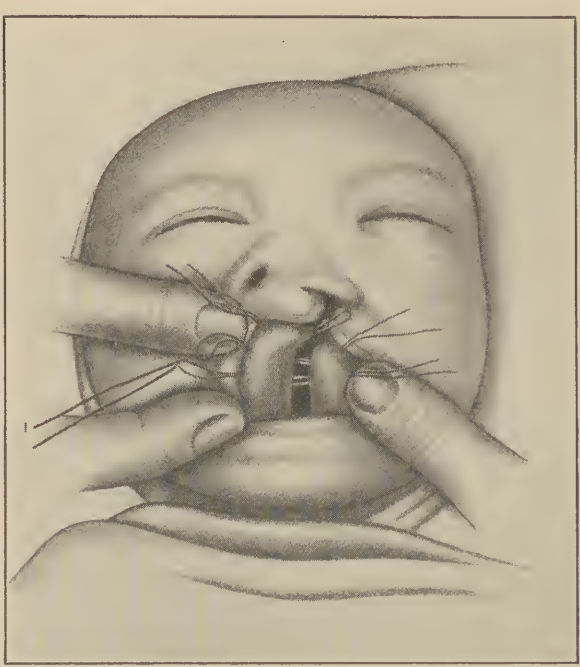


FIG. 284.—(1) Wire loop fixed in pilot suture ready to be drawn into place. Other silk loops are ready to receive the silver wire.

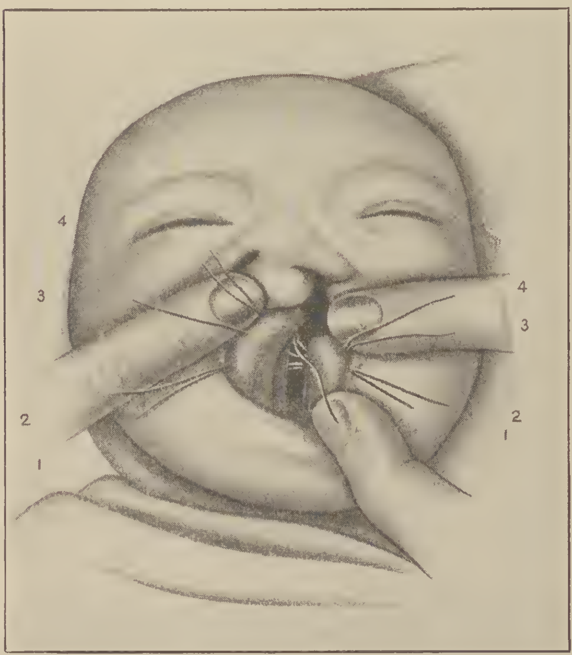


FIG. 285.—The silver wires have been drawn into place except No. 4 on the left side of the illustration. Here wire No. 4 has been threaded on the loop of the pilot suture No. 4 ready to be drawn into place.

corresponding to the places where the wires emerge from the bone. The right plate will have two wires in the posterior hole, one in the middle hole and one in the anterior. The left plate has two wires in each hole (Fig. 288). One of the posterior wires (1) on the right side should be twisted with the middle wire (2) on the same side, care being taken to keep the *twist* as near the center of the distance between the two holes in the plate as possible. It is advisable to always twist to the right. The opposite ends of these same wires 1 and 2, are then similarly twisted together on the left side. The operator must use care in twisting the *same* wires on the left side as he twisted on the right. Having these wires

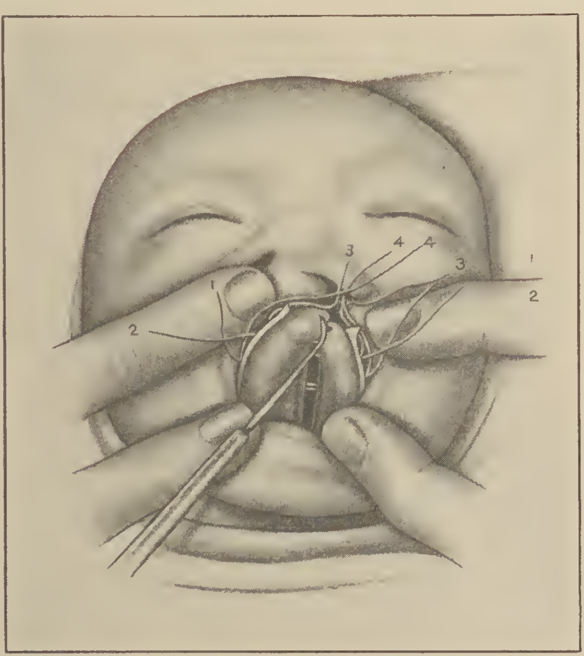


Fig. 286.—Wires and plates in position. The method of fastening the wires is shown by the numbers on each end. The compact bone covering the surface of the fissure together with the soft parts has been dissected up and carried forward, enabling the surgeon to bring cancellated bone in contact and at the same time produce a symmetrical normal alveolar ridge. See Fig. 288.

twisted up close to the plates, he then seizes the twist with a pair of forceps, draws the slack out, and, while making pressure on the plate toward the bone, he twists up the slack first on the right, then on the left side. Moving the bones together, by twisting the wires against the lead plates, should not be attempted as the force may break the wires. An instrument should be placed against the lead plate and pressure exerted toward the bone while the wire is being pulled and twisted. By so proceeding, the danger of breaking the wire will be avoided.

It will be remembered that two wires remain through the bones which have not been used (3 and 4). We now take the anterior wire (3), carry it under the lip, beneath the mucous membrane through the frænum, close to the bone and twist the ends together just in front of the cleft alveolar process and between the borders of the cleft lip. The thumb should then be placed on the long prominence of the right maxilla, really on the premaxillæ, pressure made to bend it to its normal position, and the cleft bones moved into proximity. The posterior wire on each side (4), not yet employed should be carried forward and above the twist of wires 1 and 2, and the ends twisted together to serve as a re-inforcement to the anterior wire, 3 (Fig. 286).

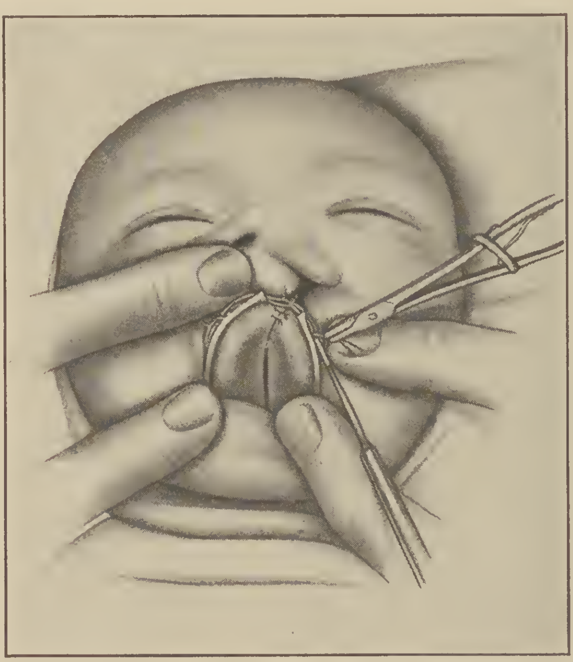


Fig. 287.—Twisting of the wires completed.

After the wires are twisted, and just before the alveolar processes are brought into contact, a small knife should be passed about one-quarter of an inch posterior to the anterior part on either side of the cleft, making flaps long enough and thick enough, when sutured, to prevent leaving a notch in the bone and to secure a normal bony arch. Horse-hair coaptation sutures should be used for fixing the little flaps in the anterior portion of the fissure. Moreover, the muco-periosteum on each side of the anterior portion of the cleft—from the nasal cavity to the lower border—should be elevated, approximated and sutured before the final

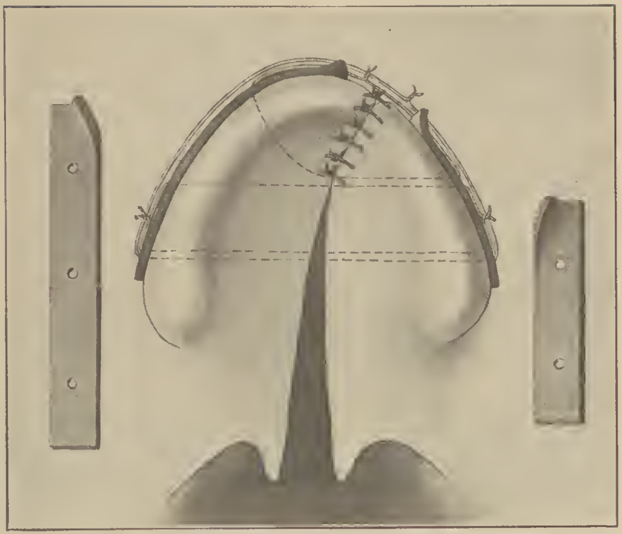


FIG. 288.—All wires and plates in position. The posterior wire in this illustration corresponds to No. 4 in Fig. 286; the next wire forward corresponds to No. 1; the next, to No. 2; and the anterior wire to No. 3, all of the same figure. Lead plates, No. 13 American gauge, are shown at the sides; perforated for the passage of the wires.

FIG. 289.—Sagittal section of the bones of the face showing cleft of the hard palate with silver sutures and lead plates adjusted.

twists of the wires are made thus preventing the depression and closing the opening between the mouth and the nose which, too often, is to be observed following cleft palate operations.

Having freshened the edges and made the anterior flaps, we make pressure again with an instrument on the lead plates, twist the wires and bring the edges of the cleft into close proximity. In my earlier work, if the edges of the cleft did not meet, I divided the mucous membrane and the bone through the malar process on both sides so the bone could be moved toward the median line. Many years ago I abandoned this step, as I found it unnecessary.

Fig. 289 shows a vertical section of the head with the wire sutures inserted and lead plates on the buccal surfaces of the bones. Fig. 290

Fig. 290.—Sagittal section of skull showing wire sutures in place. Edges of cleft are approximated.

shows the cleft in the molar region nearly approximated, the bones anterior to which *are* approximated. I wish to emphasize the fact that the wires pass *above* the hard palate and not beneath it, as has been so frequently illustrated by those unfamiliar with my work. If the wires are passed *below* the hard palate, the alveolar processes will be drawn toward the center and the hard palate tilted upward, thus defeating the object of the operation, a result similar to that which follows the use of clamps applied to the buccal surfaces of the alveolar processes. These figures clearly illustrate the efficiency of the method of moving the separated bones

together without fracture or "crushing," and the bringing of the maxillæ into normal relation with the mandible, thus removing the deformity.

It will be seen in this drawing, which is a duplicate of Fig. 215, p. 101—Professor Cryer's specimen of the skull of a fully developed embryo

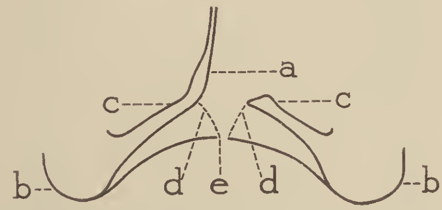


FIG. 291.—Illustration showing the position of the horizontal plates of the maxillæ and the vomer, as they usually appear in single cleft lip and cleft palate. Comparing it with Fig. 290 showing a sagittal section of a skull with wire sutures in place, we find that the horizontal plates are very greatly elevated and there is almost invariably enough tissue to close the palate. b–b, alveolar processes; c–c, horizontal plates; a, vomer; e, separation of the hard palate as it would be if the horizontal plates were lowered; d–d, lines of descending arch. The wires that are placed in the palate as shown in Fig. 290 very materially assist in lowering these plates notwithstanding the fact that the right one is united with the vomer.

cut vertically through the first deciduous premolars—that the arch is abnormally high, as we most frequently find it in cleft palate patients. The tongue is a powerful factor in displacing the elements which enter into

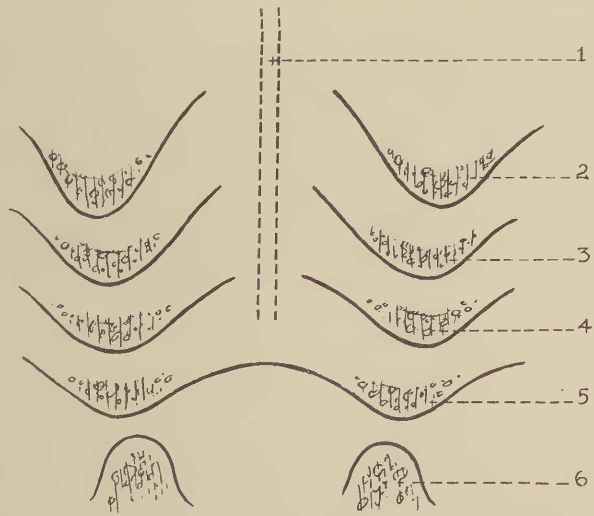


FIG. 292.—Illustrates the position of the palatal plates with different elevations of the arch. If the arch is only slightly elevated, the cleft may not be very wide, but if elevated to an extreme height and the tuberosities spread, the arch will be wider. It occasionally happens that a contracted arch is highly elevated. 1, Vomer; 2–5, different degrees of elevation; 6, mandible.

the structure of the horizontal plates of the palate. The tongue, in the early part of the third month of embryonal life, is enormously thick, occupying three or four times the space which it does at birth. At two

months it occupies the space almost as high as the orbit. At birth it is materially reduced in thickness and yet the most casual observer who is accustomed to the examination of infants with cleft palate, has noted that the tongue lies between the separated bones and far up into the nasal cavity.

It, consequently, elevates the hemispheres of the hard palate in nearly all cases, and this elevation, together with the separation, has led many to believe that there is an absence of tissue.

There is no better way of illustrating the condition of the palate shown in Fig. 291 than in the drawing of the bascule bridge. Whoever holds the opinion that there is an absence of tissue in Fig. 289, might with equal propriety say that the engineer failed to put sufficient material in this bascule bridge to complete it. Once understood, the force of the illustration will be appreciated.

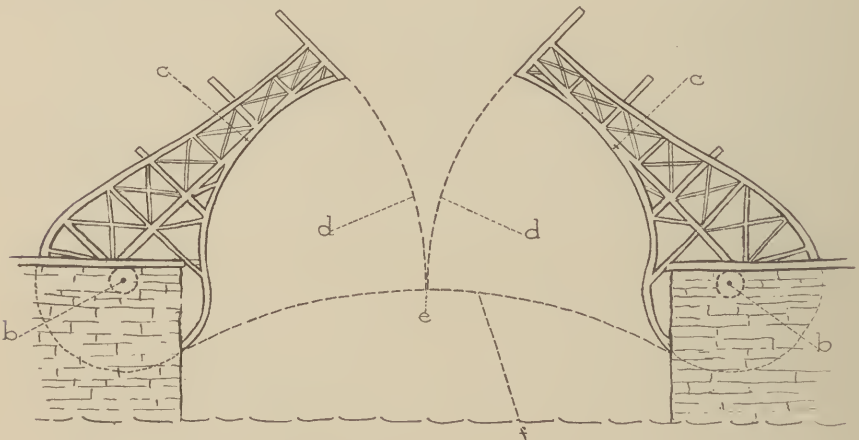


FIG. 293.—Following the lettering of Fig. 291 as far as possible, for we have no a–a representing the vomer, b–b are the pinions of the bridge which correspond to b–b the alveolar processes of Fig. 291; c–c, corresponding to the horizontal plates of the palate bones, misplaced upwards; d–d, lines of the descending arch which terminate in the meeting of the hemispheres of the bridge at e; f, line of the new arch.

Fig. 294 shows a photograph of a plaster cast of a child's mouth at 20 months of age. The cleft is darkened in the cast so as to more clearly bring out its form. This form of cleft palate is pretty generally declared by the laity as well as by many physicians and surgeons to be the result of arrested development of tissue, or incomplete development of the vault of the palate. A duplicate of this model was made and sawed in two at the dotted lines for measurement—Fig. 295.

The artist has made drawings of these casts (Fig. 296) and has marked them according to Fig. 291 which explains the condition of the palate. Here we have an abundance of tissue to form a normal palate, but it is elevated

FIG. 294.—Cast showing Cleft No. 6, author's classification. In this case, as usual, the vault is high. There is an abundance of tissue to form a normal palate if the horizontal plates of the bones were not so highly elevated.

B A

FIG. 295.—Same cast sawed in two, showing elevation of palate. B, anterior part; A posterior part.

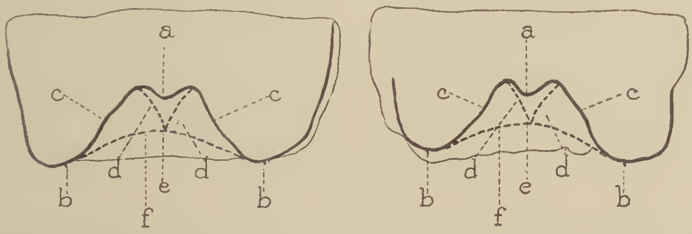


FIG. 296.—Drawing of preceding figure. a, vomer; b–b, alveolar processes; c–c, misplaced horizontal plates of the maxillæ. If a compass is placed on b and the bones at the border of the fissure, and the arm of the compass brought downwards on both sides, d, d, they meet at e, showing the meeting of the separated hemispheres of the palate. f, line of the new arch.

abnormally and the arch is spread, but not widely. We have, in fact, a superabundance of tissue to form a normal palate, but I believe that the displacement of the palatal plates has been due to the pressure of the tongue in embryonal life. If we could move the bony plates in this form of cleft downward to their normal position, we could produce at once a perfect bony arch.

The artist has made use of a compass to demonstrate what may be easily determined by anyone entering deeply into the study of this subject —that if it were possible in incomplete clefts like this to move the elevated bones of the hard palate downward and somewhat inward, we might easily approximate the borders of the cleft and make an arch of a far better form than the fissured arch even if it were united in its elevated position (see Fig. 345).

A *B* *C*

Fig. 297.—*A*, Plaster cast of mandible in an infant four weeks old; *B*, plaster cast of widely separated cleft palate in same child. The squares made above indicate the difference in the breadth of the two jaws. The upper is wider than it should be. *C*, Condition of the same palate at the age of seven years. The permanent first molars and central incisors are normal and in place. All the deciduous molars are also in place. The boy has a well-formed dental arch and a good palate. Unfortunately the plaster cast was cut too short so that the entire soft palate is not represented. This patient is one of three whom I took to London and exhibited to the Congress of North American Surgeons which met there in 1914.

In complete clefts, we bring into contact the widely separated bones of the anterior one-third of the palate and content ourselves with passing the silver wires above the hard palate, and through lead plates upon the buccal walls, tightening the wires by twisting them upon the plates—thus moving the bones assisted by the pressure of the thumb, more nearly into proximity and at the same time by the pressure of the wires upon the superior surfaces of the hard palate, move it downward and toward the median line. This establishes a bony arch and simplifies the procedure of operating upon the soft palate, together with the posterior portion of the hard palate.

This operation is attended by only slight hemorrhage. What little hemorrhage occurs is caused by the insertion of the needles and the scarifying of the edges of the cleft. This is promptly arrested by quickly moving the freshened parts in contact. If need be, a solution of 1–10,000

adrenalin chloride may be used. This, however, is rarely needed. I have found that the reaction following adrenalin chloride is considerable. For that reason I regard its use as objectionable. Fig. 297 shows the relation of the upper to the lower jaw before and after operation.

FIG. 298.—Plaster casts of Form 7 cleft palate before and after operation. The child in this case was six months old. The central incisor teeth had partially erupted. The soft palate was closed later. A good result was secured.

FIG. 299.—Plaster cast of Form 7. Cleft palate before and after approximating the bones. The cast of the closed bones was made four months after the operation.

This bone operation converts the cleft in Form 7 into a condition similar to Form 6, which is subsequently operated just before speech is attempted, that is, at 16 to 22 months.

FIG. 300.—Plaster cast of Form 7. Cleft before and after approximating the bones. Flaps of the tissues in the anterior part were made in order to avoid a notch. The cast of the closed bones was made five months after the operation.

FIG. 301.—Form 8. Tripartite cleft, extending through the soft and hard palates and the alveolar processes, separating the premaxillæ from the maxillæ. Nearly always complicated with double cleft lip.

Form 8.—*Tripartite cleft, extending through the soft and hard palates and the alveolar processes, separating the premaxillæ from the maxillæ. Nearly always complicated with double cleft lip* (Fig. 301).

In this form of cleft, we find the maxillæ widely separated. Occasionally a band or bridge of tissue may connect the premaxillæ with the maxilla of one side (Fig. 222). This band rarely connects both sides. The premaxillæ always contain the germs of the central and sometimes the lateral incisor teeth. The laterals are occasionally found to be imbedded in the substance of the maxillæ proper; or, according to the teachings of Albrecht, there may be an intervening bone between the premaxillæ and maxillæ which may contain the germs of the lateral incisor teeth (Fig. 302).

Management of Protruding Premaxillæ.—On reviewing the literature at my command, I am convinced that the protruding premaxillæ have never received the careful serious consideration which has marked the investigation of surgeons in treating other physical defects. In some

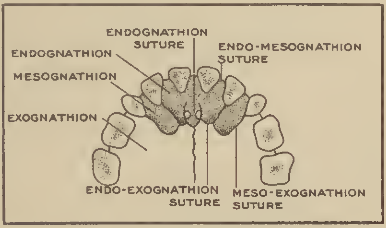


FIG. 302.—The premaxillary bone and its sutures. Shows six incisor teeth. (*Gray's Anatomy.*)

works the authors advise excising these bones, while others advocate closing the lip over them when possible. Still others advise removing a V-shaped piece from the vomer, moving the bones back and closing the lip over them. We often find the vomer divided, the premaxillæ moved backward, the cleft lip closed and no effort made to freshen the bones, assemble and stabilize them. To excise the bones is to produce an irreparable deformity. To move them in contact with the maxillæ and close the lip over them is to leave them like an un-united fracture through life (see Fig. 233).

Protruding premaxillæ separated as they are from the maxillæ, should be considered in the light of a fracture and so treated. *Under no circumstances should they be removed*, even though they amount to only a small prominence on the tip of the nose. These bones, together with the teeth which they embrace, have an important function. They add beauty and symmetry to the face. Their loss means prognathism with its unsightly deformity. The upper lip recedes and the nose becomes broad and flattened. The upper arch becomes contracted so that the upper teeth

occlude on the lingual surfaces of the lower teeth. Altogether the removal of these bones is always unnecessary, unsurgical and to be deplored.

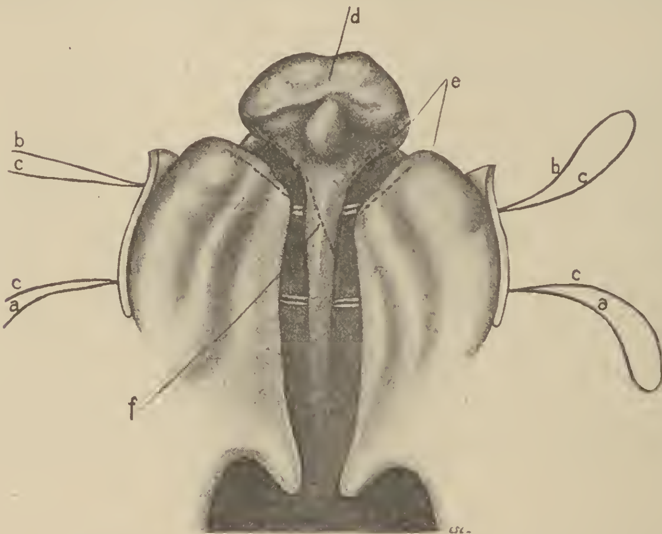


FIG. 303.—Method of treating tripartite cleft palate. The wires have been introduced as in Form 7, and the lead plates, in this form of even length, are adjusted. The dotted lines indicate the incisions. It will be noticed that the vomer is cut obliquely (*f*) so as to allow it to be moved backward into proper position. The wires, etc., are lettered in order that they may be identified in the subsequent figures.

I have stated that the premaxillæ *should never be excised, nor should they be forced back without securing bony* union with the maxillæ. It is said that the premaxillæ fail to unite with the maxillæ. If so, the fault is due to interposition of soft tissues and failure to immobilize. The

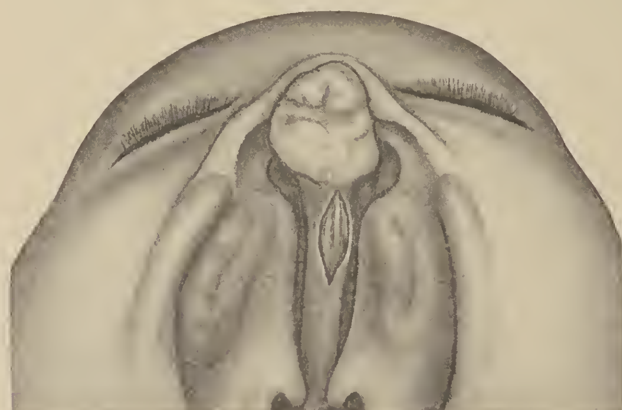


FIG. 304.—Illustrates Esmarch and Kowalzig's method of moving the premaxillæ backward. The vomer is incised and telescoped backward.

lip may be closed over the loose, floating bones, or it may be closed over the protruding bones (see Fig. 130). In either case the patient will remain deformed through life. Would a surgeon in the treatment of a compound

fracture of the femur feel that his duty was well done if he crowded the fragments into place without removing intervening tissue and then closed the external wound? Would he expect to secure bony union without

Fig. 305.—Exposure of palate with protruding premaxillæ. The oblique incision made through the vomer often serves the purpose admirably in moving the premaxillæ into position.

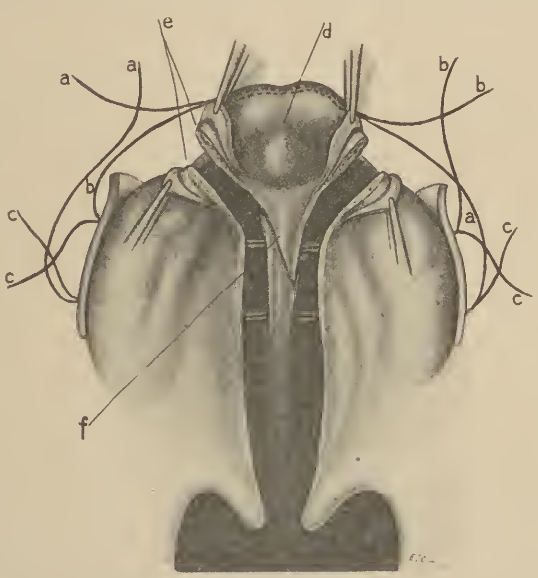


Fig. 306.—The second step in the procedure, showing the flaps made in the muco-periosteum and the compact bone removed from the surfaces to be placed in contact. It will be noticed that wire sutures have been carried through the maxillæ and the vomer. Wires are carried beneath the soft parts anterior to the premaxillæ indicated, by the dotted lines. These sutures will enable the surgeon to bring the bones into close proximity.

the adjustment of splints and without immobilizing the parts? A normal maxillary arch can be secured only by treating the parts in the same manner as one would an un-united fracture.

It would seem too apparent to require argument that these misplaced bones should be united and a normal arch secured before closing the lip.

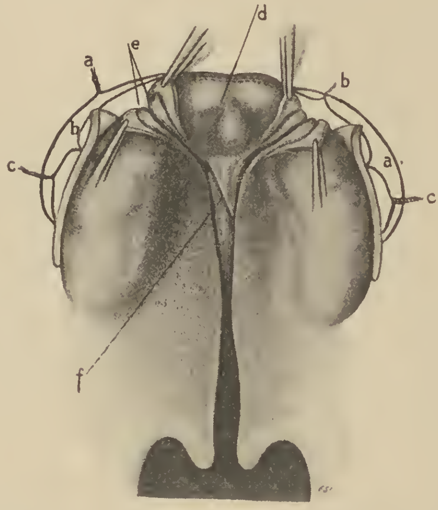


FIG. 307.—The flaps have been made in the membranes and the vomer is in correct position. The wires have been partially twisted. It will be noticed that the wire *a* is brought forward and passed beneath the muco-periosteum anterior to the premaxillæ and twisted upon the right side. The wire *b* is carried forward in the same manner and twisted upon the left side. The wires *c–c* are twisted against the lead plate so as to move the separated bones together. The *c* wires are twisted before the *a* and *b* wires. *e*, Freshened bone and mucous membrane flaps: *d*, premaxillæ.

FIG. 308.—The premaxillæ have been placed in their normal position and the flaps sutured with horse-hair. The mucous membrane over the vomer and edges of the hard palate has been split and the underlying bone freshened so that union takes place without placing any sutures in the median line. The soft palate is united later.

The surgeon's first duty in the treatment of this form of cleft is to bring the premaxillæ in proper position and move the maxillæ close in contact

with them, thus bringing the abnormally broad and elevated arch to a proper breadth and height and establishing a solid, bony alveolar ridge. The surfaces of the premaxillæ and maxillæ, which are to be placed in contact, must be freshened, brought into proximity and thoroughly immobilized. The soft parts covering the premaxillæ are elevated, making distinct flaps (Fig. 307). Flaps are also made over the maxillæ.

It will be seen that the freshened bones are ready to be approximated (Fig. 306). To secure immobility, wire sutures are inserted after the manner described under *Form* 7, and lead plates adjusted (Fig. 307). Introducing the anterior wire, the premaxillæ is not pierced by the needle which carries the silk pilot suture, but the suture is carried anterior to the bone, between it and the overlying soft parts (Fig. 306). In this manner the

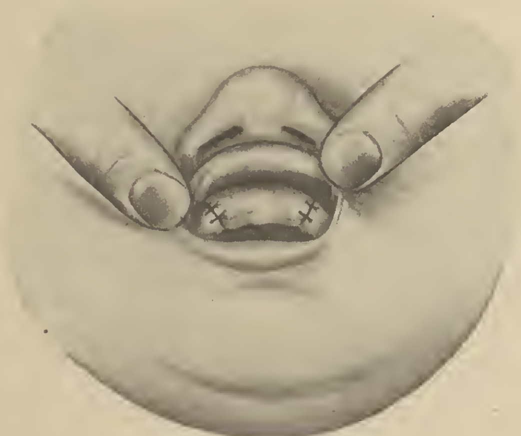


FIG. 309.—Anterior view of finished operation.

wire, by pressure, carries the bone slightly backward while the wires passing through the substance of the maxillæ bring them closer together and in contact with the lateral surfaces of the premaxillæ. The edges of the bones should be thoroughly freshened and the compact bone removed so as to allow the cancellated surfaces of the bones to meet, thus securing a bony union and a solid arch. The correct adjustment of the premaxillæ finds a counterpart in the treatment of an un-united fracture. The success of the treatment of this deformity, as in the case of the un-united fracture, will depend upon the surgeon's removing compact bone and exposing cancellated bone and securing absolute immobility. Horse-hair sutures are now introduced to unite the flaps as shown in Figs. 308 and 309.

It is important that the child should be not less than three months old when the operation of moving the premaxillæ back into position is made. At this time the bones are sufficiently ossified to prevent the

teeth contained in the premaxillæ from being displaced by the pressure exerted upon them in moving them into their normal position. In my earlier experience in operating upon children a few weeks old, I found the deciduous teeth would sometimes be lost by the pressure of moving the bones into position. It is imperative also to see that the part of the vomer attached to the premaxillæ is not turned upward and crowded against the ethmoid cells. As in older subjects, sufficient pressure may be made to produce meningitis.

This operation, when completed, results in a condition similar to Form 6 and is subsequently operated just before the child begins to talk.

Fig. 310.

Fig. 310A.

Fig. 310.—Child for whom extensively protruding premaxillæ were moved into normal position at the age of 3 months. It will be observed that the wires and lead plates are still in place, the wires passing anterior to the premaxillæ and beneath the soft parts. Instead of the usual 6 weeks to 2 months, these plates remained 5 months because the child could not be brought back sooner. This photograph was taken the day the plates were removed. The tissues were not disturbed. The central incisor teeth have erupted and the premaxillæ are firmly united to the maxillæ.

Fig. 310A.—Drawing showing lead plates; wires passing anterior to premaxillæ and beneath muco-periosteum.

Form 9.—*Cleft of entire soft palate extending through the horizontal plates of the palate bones and, irregularly, into although not through, the palatal plates of the maxillæ. The premaxillæ are separated from the maxillæ, between which and the posterior part of the cleft the hard palate is normal. Usually complicated with double cleft lip.*

The treatment of the premaxillæ is essentially the same as that described in *Form* 8. The complication of cleft lip adds to the deformity, but an operation upon the lip in all cases should be deferred until after the bones of the arch are brought in contact and united. The posterior cleft is closed at a subsequent operation, as in Form 6.

Form 10.—*Cleft only between the maxilla and premaxilla, usually on the left side and accompanied by single, sometimes double, cleft lip.*

In this cleft a pilot suture is passed from before backward between the central incisor teeth. It emerges near the palatal surfaces of the cleft.

Fig. 311.—Form 9. Cleft of entire soft palate extending through the horizontal plates of the palate bones and, irregularly, into although not through, the palatal plates of the maxillæ. The premaxillæ are separated from the maxillæ, between which and the posterior part of the cleft the hard palate is normal. Usually complicated with double cleft lip.

Fig. 312.—Form 10. Cleft only between the maxilla and premaxilla, usually on the left side and accompanied by single, sometimes double, cleft lip.

Another suture is carried between the cuspid tooth and the first molar into the fissure just above the palatal plate. The anterior pilot suture is carried between the cuspid and molar teeth by the second pilot suture. A double

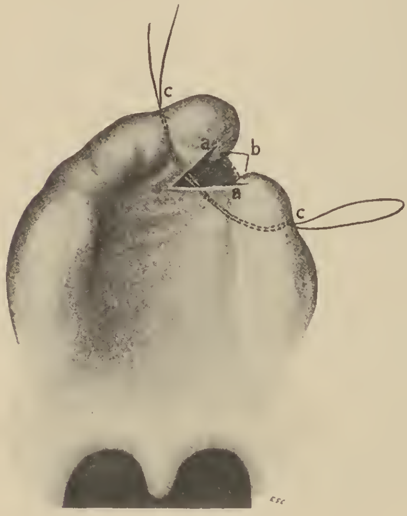


FIG. 313.

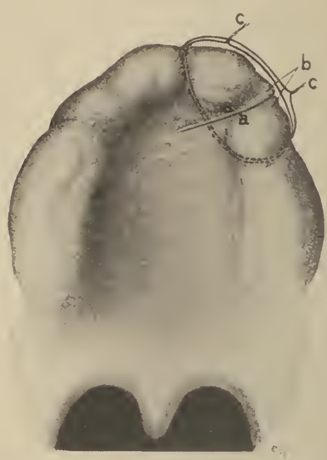


FIG. 314.

FIG. 313.—This illustrates the introduction of wire sutures to close the cleft. In a young infant the bones can be easily bent and a normal arch formed.

FIG. 314.—Operation completed. The soft parts have been everted so as to prevent the formation of a notch.

FIG. 315.—A cast of a small anterior cleft, through the alveolar ridge only. Form 10.

silver wire is then pulled through by means of the anterior pilot suture. The wire now passes through the separated bones (Fig. 313).

The muco-periosteum is incised and reflected forward. The compact bone tissue is removed by means of a knife or chisel. The prominent premaxilla is carried backward in contact with the denuded maxilla by pressure applied by the thumb. The wires are then twisted. The bones are now in firm contact. The muco-periosteal flaps are then sutured with horse-hair (Fig. 308). A normal bony arch is thus formed.

In older patients it is necessary to make an incision through the anterior alveolar plate on the long side between the lateral and cuspid teeth. Pressure is made on the protruding part of the bone and a green stick fracture produced in the palatal plate. This allows the bones to come together. The wires are then passed as previously described and the operation completed.

Overcoming the Notch in the Alveolar Ridge.—By reason of failure of union of the bones, the anterior borders of the cleft are curved or rounded.

Fig. 316.

Fig. 317.

Fig. 316.—Plaster cast showing a broad cleft of the alveolar process.

Fig. 317.—Plaster cast showing a cleft through the alveolar ridge only. The central incisor teeth are erupted. The removal of the deformity may be easily accomplished in early infancy, but is more difficult in older patients since the bones cannot be moved into position without fracture.

It will be seen that an approximation of these rounded borders would leave a notch in the bony ridge. To prevent this I now modify this portion of the operation by making two flaps, lifting them up and uniting them with horsehair in such a way as to leave, at the time of the operation, a slight projection along the borders of the bone. This secures after contraction, a smooth, well-formed, normal and solid arch. Previous to this modification it was my practice to remove the mucous membrane and compact bone without making the flaps.

It is a fact well recognized by every experienced, observing surgeon that the teeth in immediate contact with the border of the cleft are invariably so irregular in position as to be of little consequence. Especially is this true of the lateral incisors which on the defective side are frequently absent but if present often occupy transverse positions and generally cannot be successfully regulated; they are frequently not amenable to orthodontia. Sometimes these lateral incisor teeth have no alveoli; they are attached only to the mucous membrane. The loss of these teeth in

Fig. 318.—Form 11. Cleft completely separating the premaxillæ from the maxillæ. The palate otherwise is normal. Usually accompanied by double cleft lip.

making the flaps for the purpose of overcoming or preventing the permanent defect, which the notch in the bone causes, is of small importance, while the prevention of the deformity is of the greatest value. It is not necessary, however, to remove the germ of the cuspid tooth nor even the lateral incisor in making the flaps that I have mentioned. The permanent germs are seldom disturbed.

Form 11.—*Cleft completely separating the premaxillæ from the maxillæ. The palate otherwise is normal. Usually accompanied by double cleft lip* (Fig. 318).

This deformity is quite common. The palatal plates of the maxillæ proper, the horizontal plates of the palate bones and the soft palate throughout its entire length are normal. Occasionally the premaxillæ protrude considerably, forcing the segment of the lip towards the end of the nose and sometimes beyond (see Cleft Lip). The treatment to be employed

in the management of this deformity is to establish the continuity of the alveolar border by carrying the premaxillæ backward to their place, immobilizing them by the use of wire sutures and freshening the surfaces which are brought into contact as in previously described operations (Figs. 319 and 320).

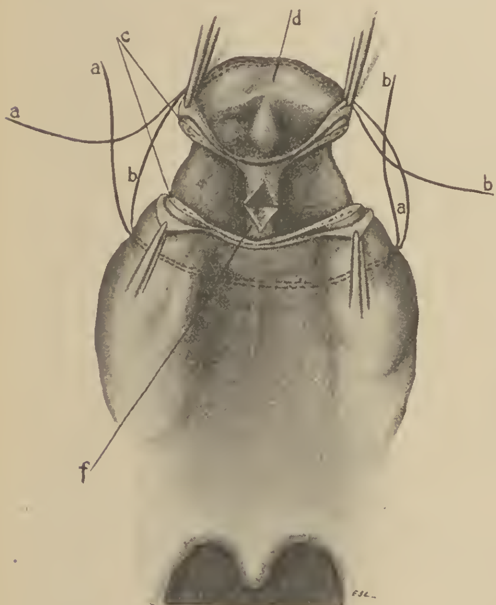


FIG. 319.

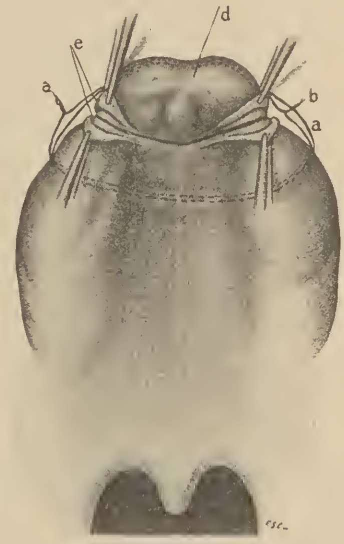


FIG. 320.

FIG. 319.—Shows method of closing Form 11 cleft. The muco-periosteum has been reflected outward (none has been removed), the compact bone removed and wires carried through the maxillæ and anterior to the premaxillæ. A V-shaped piece has been taken away from the vomer so as to allow the premaxillæ to be moved backward into their proper position. The dotted lines show the course of the wires above the hard palate and anterior to the premaxillæ.

FIG. 320.—Showing the wires twisted, the premaxillæ immobilized and the flaps ready to be sutured with horse-hair. The use of lead plates is not necessary in this operation.

Form 12.—*Cleft only of the anterior one-third or one-half of the hard palate with protruding premaxillæ which are entirely separated from the maxillæ. This condition is usually complicated with double cleft lip* (Fig. 321).

This form is to be treated substantially the same as *Form* 11. The management of the elongated vomer has received a great deal of attention and various methods have been proposed to change the parts so as to establish the contour of the arch. In my earlier practice I was in the habit of removing a V-shaped piece from the vomer, thus enabling me to carry the protruding premaxillæ backward to their place (Fig. 322). More recently I have been making an oblique incision through the lower part of the vomer, then bending the premaxillæ back into place (Fig. 305). A wire

suture, carried through the maxillæ and through the vomer, as described in Figs. 303 to 310, will enable the surgeon to bring the bones into close

FIG. 321.—Form 12.—Cleft only of the anterior one-third or one-half of the hard palate with protruding premaxillæ which are entirely separated from the maxillæ. This condition is usually complicated with double cleft lip.

proximity, and with the anterior wire carried between the premaxillæ and the overlying soft parts, he can promote union of the parts and

FIG. 322.

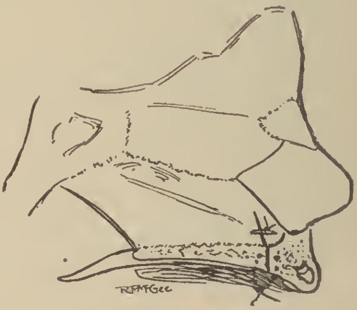


FIG. 323.

FIG. 322.—Vertical section of palate nasal region of a child nine weeks of age, showing cleft palate and bilateral cleft lip and protrusion of the premaxillæ. Protruding bones placed in their proper position and held by silver sutures. Germs of the incisors undisturbed. *a*. Protruding premaxillæ containing germs of the temporary central incisors. *b*. V-shaped incision in the vomer, indicated by dotted lines.

FIG. 323.—Premaxillæ are carried back into position and sutured with silver wire.

establish *a firm, bony arch.* Like a fracture, lack of union is often due to failure to secure quiet contact.

Form 13.—*Cleft of the entire soft and hard palates extending through the alveolar ridge on one side. The premaxillæ are completely separated from the maxillæ on the one side and partially on the other* (Fig. 324).

The treatment consists in closing the cleft of the bones as described under *Form* 8. The soft palate is closed when the child has reached the age of 16 to 22 months, as in Form 6.

Fig. 324.—Form 13. Cleft of the entire soft and hard palates extending through the alveolar ridge on one side. The premaxillæ are completely separated from the maxillæ on the one side, and partially on the other.

Form 14.—*Cleft of the soft palate, partial or complete, while the hard palate is normal save for a cleft in the alveolar border. Usually accompanied by single cleft lip* (Fig. 325).

This cleft is a combination of *Forms* 3 *and* 10. The cleft of the soft palate may extend farther forward. The anterior cleft may be closed as described under *Form* 10. The posterior cleft may be closed as described in *Form* 4 when the patient reaches the age of 16 to 22 months.

Form 15.—*Cleft only of the alveolar process anterior to the maxillæ, due to the non-development or absence of the premaxillæ. Such cases are usually accompanied by cleft lip*[1] *in the median line* (Fig. 326). *Inoperable.*

In the light of our present knowledge, surgery can do nothing to overcome the deformity described in *Form* 15. The absence of the premaxillæ leaves a depression, a large notch in the anterior part of the palate, which

[1] Seven cases in the author's practice were accompanied by single cleft lip in the median line.

Fig. 325.—Form 14. Cleft of the soft palate, partial or complete, while the hard palate is normal save for a cleft in the alveolar border. Usually accompanied by single cleft lip.

Fig. 326.—Form 15. Cleft only of the alveolar process anterior to the maxillæ, due to the non-development or absence of the premaxillæ. Such cases are usually accompanied by cleft lip in the median line. Occasionally only a slight notch is found in the alveolar border.

must so remain. The literature of the subject at my command furnishes only twenty-one examples of the absence of the premaxillæ and cleft lip

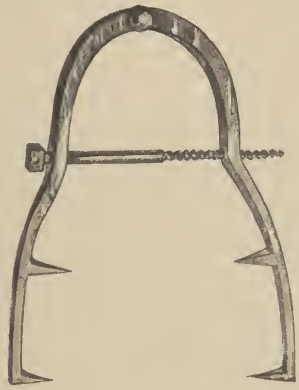


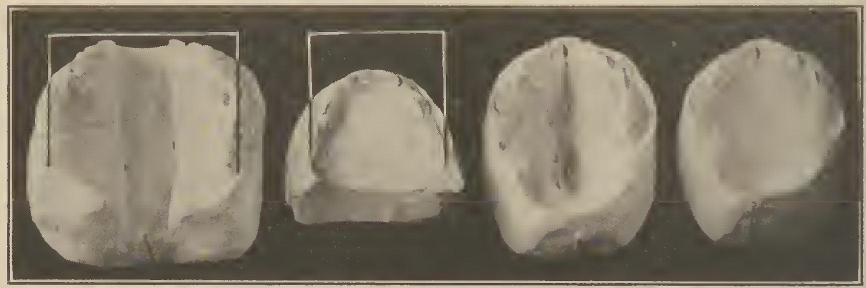
FIG. 327.—Author's steel clamp devised in 1884 and employed to approximate the edges of the cleft bones.

in the median line. The cleft lip should be closed. The upper arch should be kept expanded by orthodontic appliances and when the permanent teeth have fully developed prosthesis can be adjusted. This

FIG. 328.—Form 16. Cleft in median line, maxillæ separated at central suture, and palate cleft throughout entire length. The only case recorded is this, a child of 18 months, hence the teeth appearing in photographs and drawings.

will supply teeth, correct the recession of the lip as far as possible and establish facial contour.

Fig. 327 shows a steel clamp devised by the author in 1884, which was employed in certain cases for the purpose of approximating the edges of the cleft bones. This clamp would sometimes move the separated bones into contact, but would more frequently tip the alveolar processes inward while the edges of the cleft were more highly elevated and remained separated.



a *b* *c* *d*

Fig. 329.—Photograph of casts, Form 16, showing comparative breadth of upper, *a*, and lower, *b*, jaws, the position of the teeth, and an accurate presentation of the separated bones. *c*. The bones in the anterior part of the hard palate are in contact, but the soft palate is not yet closed. *d*. Cast of the palate united throughout its entire length.

It did not meet with my expectations as its motion kept up irritation and besides its work was otherwise unsatisfactory. It was finally abandoned as the work was satisfactorily accomplished by the use of wire sutures and lead plates. Several writers on the subject have also devised steel clamps

a *b*

Fig. 330.—*a*, Cast of the upper and lower teeth. It shows that all the upper teeth telescope over the lower teeth; that the lower jaw, acting like a wedge, drives the segments of the upper jaw farther and farther apart. The lower teeth buried themselves in the soft parts of the hard palate, causing the patient great distress. *b*. Cast of the upper and lower jaws after the separated upper jaw had been narrowed to its normal width.

for this purpose. It is my opinion that these clamps for the approximation of the cleft of the hard palate will prove as unsatisfactory in the hands of others as they have in mine.

Form 16.—*Cleft in median line. The premaxillæ are separated at the central suture. The palate is cleft throughout its entire length* (Figs. 328–333).

CLEFT PALATE EXTRAORDINARY[1]

It is common for a cleft to extend through the palatal plates of the maxillæ as well as the horizontal plates of the palate bones and then extend forward, separating the premaxillæ from the maxillæ, including the alveolar ridge, thus forming a complete separation from the nostril back to the extreme distal end of the palate. Or, it may separate the premaxillæ from the maxillæ completely, and then extend backward in the median line to the end of the palate. I have never before, however, found a case showing a cleft of the palate in the median line, with the premaxillæ separated at the central suture and the palate cleft throughout the entire length, nor does a careful review of surgical literature furnish a single example of a deformity of this character.[2] So far as I know, the case recorded here for the first time is the only one of its kind reported.

This patient came into my practice in June, 1919, at the age of 14 months. She presented a deformity of far more than usual interest. On examining Figs. 329 to 333 it will be observed that the palate was separated in the median line beginning with the premaxillæ and extending backward the entire length of the hard and soft palates. The lip also was divided in the median line.

A central incisor tooth occupied each premaxillæ. The extreme breadth of the cleft (Figs. 331 and 333) and the age of the child presented a problem which was by no means easy to solve. The lower teeth did not occlude with the upper teeth, but came in contact with the soft parts covering the palatal surfaces. Ossification had so far advanced that the bending of the bones and moving them together was impossible. Immediate closure of this broad cleft could be effected only by fracture of the bones. In a child of this age, fracture would be a very hazardous procedure.

After careful consideration I resolved to move the bones together by passing wire sutures through them, keeping the sutures above the hard palate. A double suture was carried through the bones in three different places. Heavy lead plates, No. 13 American gauge, were perforated in three places and double wires were carried through these holes and twisted upon the plates, a little force being applied so that the wires might be well tightened. Two anterior and two posterior wires were carried around anteriorly to the premaxillæ and tightened. No further progress was made at this time.

Ten days later the patient was anæsthetized, the slack drawn out, and the wires tightened. From time to time, at intervals of about 10 days, this tightening process was repeated until at the end of the third month, without having particularly disturbed the patient, I found, to

[1] Published in *Surgery, Gynecology and Obstetrics, February, 1921, pp. 182, 183.*

[2] Wishing to obtain an opinion from the best authority on anatomical anomalies I wrote Sir Arthur Keith, Director of the Museum of the Royal College of Surgeons, London, who replied as follows:

"Your case of median cleft of the palate makes one think furiously. The condition is new to me; we have no example of it here. It seems to upset our belief that the premaxillary element is developed in the median nasal (fronto-nasal) process. It must be able to arise from the maxillary process; otherwise, we cannot explain the condition shown in your case.

"Accept my thanks for drawing my attention to the condition. I will look round for further evidence for you." (*Keith*)

A second letter on the subject, written later in the summer says: "The note you quote in your letter still represents my opinion of your case. That we have no example like it in the Museum of this College and that the condition is not easily explained on our present knowledge relating to the development of the normal palate."


FIG. 331. FIG. 332.

FIG. 331.—Photograph showing complete separation of the upper jaw. The columna of the nose is attached to the left side, while the bones are separated exactly in the center.

FIG. 332.—Photograph at the age of seventeen months, three months after the sutures and lead plates were adjusted. It will be seen that the segments of the bones of the palate are in contact. (The wires and lead plates are visible in the photograph.) At this time all wires and plates were removed.

FIG. 333.—Photograph showing child before and after treatment.

my delight, that the anterior parts of the cleft (the separated premaxillæ) were in contact and the edges posteriorly were nearly so. After the parts were approximated, all the wires were removed and new ones placed in the anterior part through the openings occupied by the former wires. The surfaces in contact were freshened, the compact bone removed, and the cancellated bone exposed. The soft parts were sutured together with horsehair and the new wires were so tightened that the freshened bones were brought into immediate contact. With the soft parts closed by horsehair sutures, the patient was dismissed and after a lapse of 6 weeks, the lip was closed. One month after the closure of the lip, the remaining portion of the palate was united, completing the operation.

This case sets aside most emphatically the theory that has been advanced, to the effect that wiring of the bones and bringing them into con-

FIG. 334.—Anterior view of median cleft of premaxillæ of dog. (Museum of Royal College of Surgeons.)

tact in cleft palate patients cannot be done subsequent to the sixth month. In my early experience I believed that the maxillæ should not be moved together after the sixth month, because at that time they were well ossified and the teeth were erupting. Since my experience with this child, I have moved together the bones in a patient of 4 years. I am satisfied that any young person who has a broad cleft of the palate may have the deformity overcome by wiring the bones together in the manner I have described and the palate subsequently closed with good results. Theories in regard to surgical procedures are of little consequence

when set aside by facts in cases like this. The child is a healthy, vigorous girl.

The moving of the bones together by the slow process is not unlike the work of the orthodontist who, by his ingenious devices, moves a tooth or teeth to almost any location he desires, but he must move them slowly so as not to interfere with the circulation. In the vast field of oral surgery, as in other branches of surgery, new questions are constantly coming up, requiring most careful consideration before operation is made. And then,

FIG. 335.—Palatal view of Fig. 334.

oftentimes, no precedents are to be found which will guide the surgeon in his work.

My experience in the war hospitals of France convinced me that in gunshot wounds of the mouth and jaws, the first impulse of the surgeon is to manipulate the bones by reconstruction so that they will occupy their proper places and, following this, plastic surgery may be more satisfactorily performed.

This case demonstrates most decidedly that any complete separation of the bones of the palate calls first for bone surgery. Plastics of the lip and

FIG. 336.

FIG. 337.

FIG. 338.

FIGS. 336 to 338.—Illustrate the author's method of moving the bones together in a child fourteen months old. The space between the maxillæ was so wide that the premaxillary bones could not fill it. In three months' time, the bones were approximated by the slow process of twisting the wires upon the lead plates from time to time. The premaxillary bones were then placed in proper position and firmly wired. FIG. 336.—Plaster cast of the lower jaw. FIG. 337.—Plaster cast of the upper jaw before operation. The upper teeth telescoped over the lower. The lower teeth came into direct contact with the mucous membrane of the hard palate. FIG. 338.—Lead plates placed on a plaster cast. The wires are shown passing through the bone and twisted against the lead plates, for the purpose of approximating the bones. For comparison see Fig. 332.

soft palate should be performed in the order named. To have attempted to close this child's lip first, before the bones were approximated, would have been a great mistake. Had it been operated upon in early infancy, no doubt the traction of the orbicularis oris muscle would to some extent have drawn the alveolar processes toward each other, but whoever so operated and concealed the more complicated deformity in the mouth would have left the patient deformed for life.

Besides, close study and experience has taught us that when the anterior part of the fissure only is approximated the tuberosities of the bones spread farther apart, the soft palate is shortened and defective articulation after union is secured is nearly always the result.

The only example of cleft palate in the median line furnished by the Museum of the Royal College of Surgeons is the separation of the anterior part, through the premaxillæ in a dog, an illustration of which here appears, Figs. 334 and 335. The palate in this dog, however, is not separated throughout its entire length, only the premaxillæ being involved.

SPREADING OF THE ARCH

An impression prevails among very many practitioners that if the upper and lower teeth occlude correctly, the arch must be normal. On the contrary, every orthodontist realizes that both the upper and

Fig. 339.

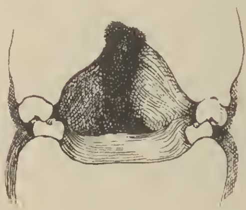


Fig. 340.

Fig. 339.—Plaster cast of mouth of boy aged thirteen, with cleft palate, showing teetn of upper jaw outside of teeth of lower jaw.

Fig. 340.—This section of a cast shows the lingual cusps of the upper molars articulating with the buccal cusps of the lower molars. The pressure results in spreading the lower jaw to correspond with the abnormal breadth of the upper jaw.

lower arch may be either abnormally narrow or abnormally broad. In patients who have cleft palate the arch is almost invariably abnormally broad. At birth it is wider anteriorly than posteriorly but the posterior part continues to spread with the passing of time.

Fig. 339 shows that when the upper arch spreads, if the lingual cusps of the upper molars occlude so as to rest over the buccal cusps of the lower molars, that the lower molars will continue to move outwards and consequently will continue to maintain occlusion with the upper molars.

With the increasing force of mastication, the mandible in turn drives the tuberosities of the jaws farther and farther apart. This holds good, as has

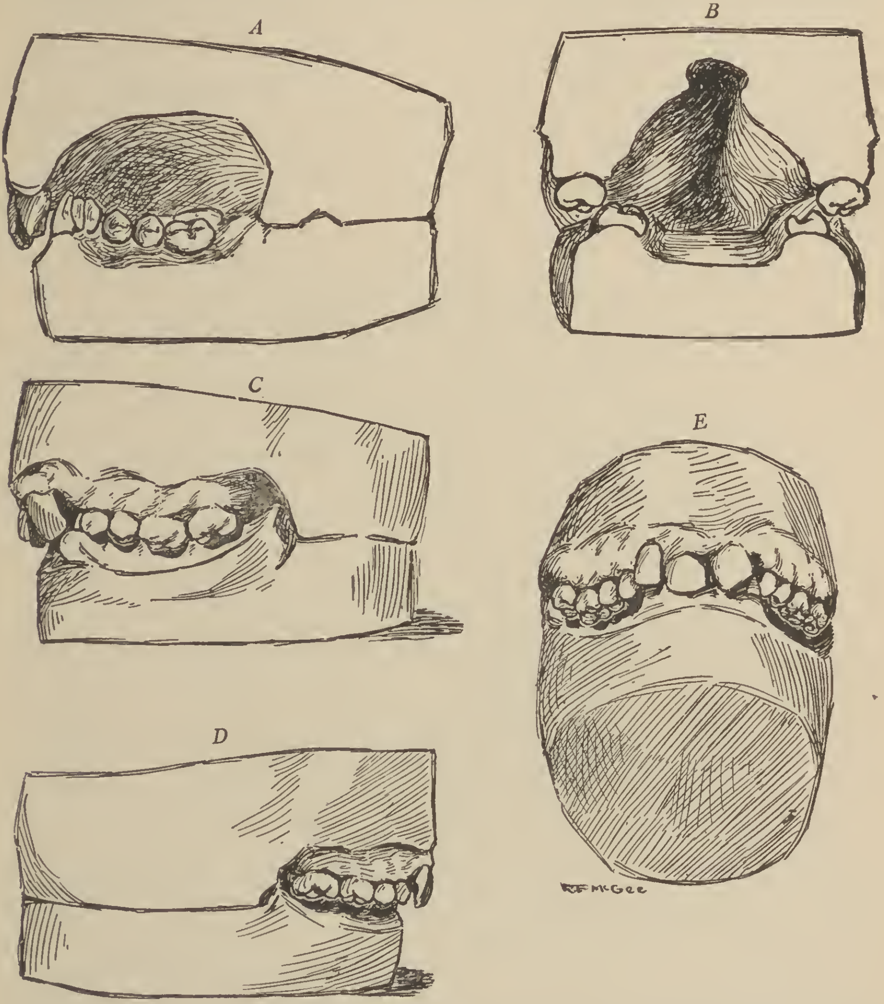


FIG. 340*a*.—*A* and *B*, sectional drawings of the mouth of a boy thirteen years of age, with cleft palate, showing the overbite. *C*, *D*, and *E*, different views of the same mouth, showing the overbite of all the superior teeth when the models are articulated. It will be seen that the lower molar teeth come in contact with the mucous membrane covering the hard palate. This membrane is often penetrated by the lower teeth. Injury to the parts calls for immediate treatment. In this case, by adjusting strong bands upon the upper molar and bicuspid teeth to which jack screws were applied, the arch was narrowed. Bands were also applied to the lower bicuspid and molar teeth to which a wire spring was adjusted to expand the lower arch. By this means the upper and lower teeth were brought into occlusion. One year later the cleft palate was closed.

been noted before, in cases only where the anterior part of the cleft has been closed, leaving the tuberosities to become increasingly separated.

Fig. 340*a*, reproduced from page 130, illustrates a cast made from one of the author's patients of many years ago. Here all of the teeth of the upper

jaw telescope over the teeth of the lower jaw, no two teeth of the denture occluding save only one incisor tooth above which could be brought to bear upon the lower incisors. Had the buccal cusps of the lower molars met the lingual cusps of the upper molars, as shown in Fig. 340, the lower arch would have spread likewise.

I believe the most important consideration that should present itself to the mind of the surgeon who operates upon cleft lip and cleft palate, is the order of procedure, from the beginning of his work until he has reached the end.

FIG. 341.—The object of this splendid anatomical drawing is to show the pivotal position of the malar process, so when the maxillæ are moved together in their anterior parts only, this process, as stated, acting as a pivot allows the tuberosities of the jaws to spread farther and farther apart.

There are, anatomically, sixteen forms of cleft palate, all of which I have illustrated in this book. The legend describing each form states to what extent the tissues are separated, describing the anatomical parts involved in the separation. If the separation is complete throughout the entire length of the palate with either single or double cleft lip with protruding premaxillæ I have held that the bones should always be operated upon first. In the last few years I have been more deeply impressed than in my earlier experience with reasons which have not hitherto been presented, why it is very detrimental to the patient to postpone moving the bones together.

The illustrations, including Fig. 233 to Fig. 244, clearly show that the approximation of the anterior part of the palate only, which may be

accomplished by traction of the m. orbicularis oris following early closure of cleft lip, or by passing a wire through the anterior part of the separated alveolar process, almost invariably separates more widely the tuberosities of the jaws and broadens the fissure in its posterior part. Anyone who will examine the mouth of a patient for whom the lip has been first closed can see at a glance that the approximation of the anterior part of the cleft also broadens the cleft in its posterior part. The breadth of the separation is greater than that which existed in the anterior part prior to the meeting of these surfaces (Fig. 242).

FIG. 342.—Palatal surface of adult's mouth showing congenital cleft of hard and soft palates.

While in London in September, 1921, I was invited to visit Guy's Hospital so that I might see in practical cases that normal occlusion of the teeth always occurs in patients for whom cleft palate operations have *not* been made and in some upon whom operations have been made. I visited the hospital, examined a number of the patients—as I remember, nine—and there was not in a single case, with one exception, a patient whose posterior teeth were in normal position, neither upper nor lower, yet the teeth occluded well. The arches in the posterior part were all abnormally separated, as there was no resistance against separation, while

the lower teeth, as shown in Fig. 237, by reason of the occlusion, followed the upper teeth with the spreading of the arch (Fig. 238). It is a habit of Nature to adjust the normal parts to abnormalities which exist. The malar process acts as a pivot, (Fig. 341) so the anterior parts of the arch move toward each other while at the same time the posterior parts of the arch, or the tuberosities of the jaw, move farther apart.

FIG. 343.—Author's method of denuding the bone of muco-periosteum. The membranes are lifted as shown by the dotted line.

Now, what is the situation when subsequently this broadened posterior cleft confronts the surgeon? He closes it by denuding the hard palate of the muco-periosteum, freshening the edges of the cleft and bringing them into contact if possible (usually it can be done), but here he has a soft palate which has been materially shortened by the spreading of the arch. The farther the tuberosities are separated, the shorter the palate will be. Distinct phonation is, therefore, impossible as the palate cannot reach the posterior pharyngeal wall. It is well known that the cleft palate nasal accent is due to a short palate. Patients whose palates are so treated

cannot talk well, unless the palato-pharyngeal muscles are utilized to lengthen the palate.

If there were no other reason for approximating the bones in early infancy than this, it is a reason so imperative for the welfare of the patient that when once understood it would seem this fact would be accepted and the patient treated accordingly.

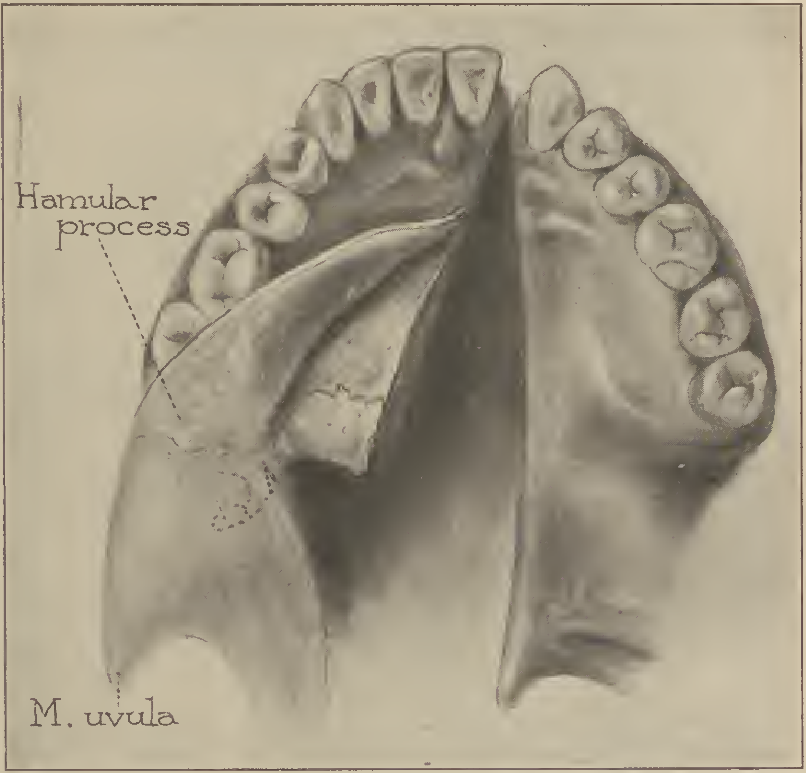


FIG. 344.—The muco-periosteum is denuded from the bones of the palate as far back as the hamular process of the sphenoid bone. The flaps are then approximated and united.

The retention of the tuberosities of the maxillæ in a normal position is essential to the production of a normal soft palate, and a normal soft palate is essential to normal articulation.

Form 7.—*Complete single cleft of the entire soft and hard palates including the alveolar process. The maxilla is separated from the premaxilla usually on the left side and accompanied by single cleft lip.*

Operation for Adults.—In the treatment of congenital deformities, the surgeon's first duty is to study carefully the condition of the parts and decide what service will remove the deformity and bring to his patient the highest degree of comfort and satisfaction. In the management of

FIG. 345.—Velum separated from the bones and palate lengthened. After the membranes are loosened from the bones, the traction of the palato-pharyngeal and palatoglossal muscles pull the palate downward and backward toward the posterior wall of the pharynx. This makes palatal function possible. It is well known that it is necessary for the palate to close the posterior pharyngeal opening to make certain sounds in articulation. The partially straightened soft parts (*B* and *C*), when released from the bone (*A* and *F*), must necessarily reach farther backward than they did when following the curved bony arch.

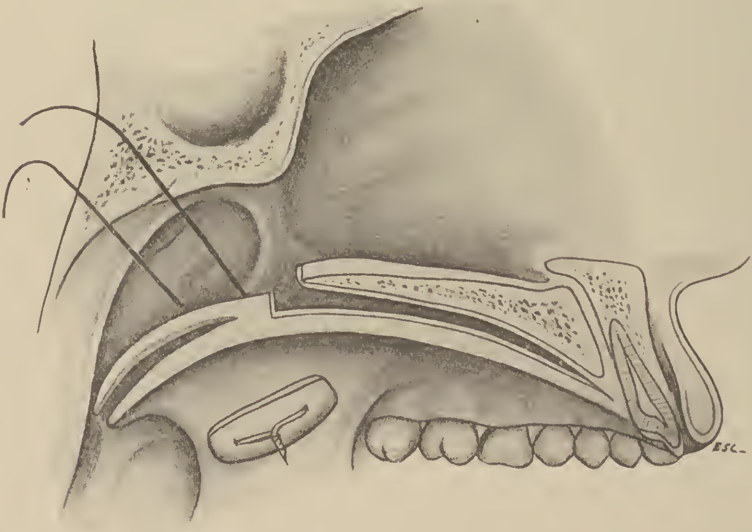


FIG. 346.—Sagittal section of palate showing the left side with author's plate in position. Sutures carried through and plate adjusted.

cleft palate, either congenital or acquired, he must decide as to the expediency of an operation, for there are adult patients on whom an attempt to operate would be unwise. With the employment of modern surgical methods in cleft palate operations, we secure as high a percentage of good results as follow other operations. This is a marked improvement over the surgery prior to 1885, when a large majority of palate operations

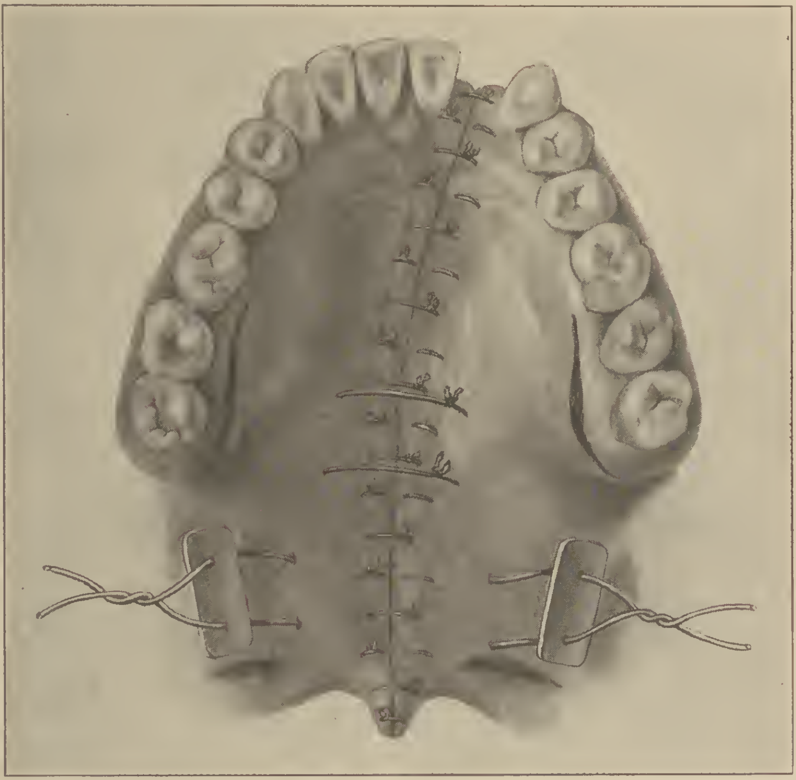


FIG. 347.—Complete single cleft palate closed by use of horse-hair mattress and interrupted sutures alternating. This combination of the two forms of sutures is very satisfactory.

were unsuccessful, either by failure of union or, if securing union, failure of function. It is the surgeon's duty, when a case is inoperable, to place his patient in the hands of an expert capable of constructing for him a useful artificial palate. I regard as inoperable a case in which there is an absence of tissue or one in which there is so little tissue that the construction of a palate surgically would be impossible even though we use the pharyngeal muscles (Fig. 446). These cases are extremely rare. It is in inoperable cases that prosthesis is indicated.

If the cleft extends between the left maxilla and the left premaxilla (Fig. 342) as it most frequently does, the vomer, as a rule, is attached to

the hard palate of the right side. The treatment described for Form 4 should be employed, varying the procedure so as to meet the requirements of the more extensive deformity. This consists in denuding the bone of the muco-periosteum to the anterior extremity of the cleft (Figs. 343 and 344). Case must be exercised in avoiding the palatine arteries. The paring of the edges and the introduction of the wire sutures should be carried out as in Form 4 (Fig. 253). The lead plates should be longer

FIG. 348.—Two wire sutures with author's lead plates are nearly always sufficient. Coaptation horse-hair sutures show in the median line. The mattress sutures used here serve better when alternated with interrupted ones (see Fig. 347).

than in Form 6 and the holes in them should be farther apart (Figs. 346 and 347).

Precaution.—After the lead plates have been placed incont act with the surfaces of the palate and the wires are twisted so as to bring the palate edges together, care must be taken not to twist the wires too tight. If too much pressure is made by the plate against the palate, the circulation may be cut off and the tissues lost. This accident should not occur and will not if the surgeon is cautious in adjusting the plates and carefully examining the sutures to determine that the vessels are not occluded.

A

B

Fig. 349.—*A*, Extremely wide cleft before operation. A good result was secured without making lateral incisions. *B*, Palate closed. Lead plates seen upon the surface.

A

B

FIG. 350.—Cleft palate, before and after operation. Lead plates in position. These pictures show the use of the oral speculum.

FIG. 351.—Plaster cast of an adult before and after operation. The arch was high. No lateral incisions were made.

FIG. 352.—Cleft palate and double cleft lip in a man thirty years of age.

FIG. 353.—Shows palate perfectly united. The lead plates are visible in the soft parts.

FIG. 354A.—Illustrates alveolar borders after the patient has, unfortunately, reached an age when the bones cannot be easily bent and brought into proper relation. (*Shearer.*)

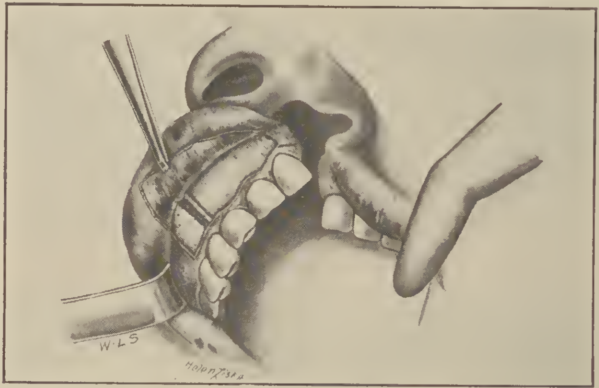


FIG 354B.—Diagrammatic of modification of Brophy greenstick fracture operation. (*Shearer.*)

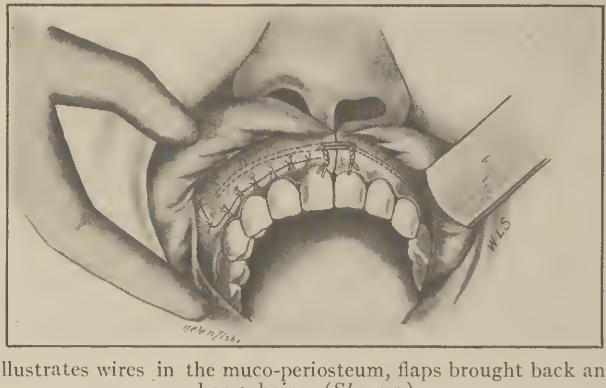


FIG. 354C.—Illustrates wires in the muco-periosteum, flaps brought back and sutured with horse hair. (*Shearer.*)

Fig. 354 a, b, c, This is a modification of the Brophy operation, made by Dr. W. L. Shearer. The illustrations very accurately show the technic. The external plate of the bone is divided with a chisel. A greenstick fracture of the internal plate is made. The wires are tightened as the bone is approximated.

FIG. 355.

FIG. 356.

FIGS. 355 and 356.—Obturators which were worn by patients for whom the cleft has been closed with the most satisfactory results.

SUMMARY

1. The Author's operation for the treatment of congenital cleft of the hard palate consists in taking advantage of the opportunity offered in very early infancy, to move the bones in contact when they are soft and easily bent and to carry them as nearly as possible into their normal relation.[1]

2. Bone, at birth, is about one-half organic matter, hence the bending and moving of the separated bones of the palate into contact may be easily accomplished.

3. To wait until the bones have become more widely separated and more highly ossified, the teeth erupted and the deformity increased, is to invite complications that should be avoided.

4. It must be understood that these bones are not 'crushed,' as has been said by men unfamiliar with the operation (crushing means comminution). To crush the bones in performing this operation within the first six months of life would be impossible. They are not broken, but, at a time in life when they are soft and flexible, they are bent and moved into correct relation and united.

5. This operation is attended by only slight hemorrhage, as we divide no vessels. The hemorrhage which occurs is caused only by the passing of the needles and the scarifying of the borders of the cleft just before its edges are brought in contact.

6. The surgical shock is less in a young infant than it would be in an older one. The nervous system of a young child is not so well developed and is not, therefore, capable of receiving the same impressions as it is later in life. Besides, young children usually react better.[2] Moreover, the element of mental apprehension is not present, and we know that alarm and dread are among the most powerful factors in producing shock.

7. If the muscles are brought into action early, they develop instead of atrophy. Hence, a good velum is secured with plenty of tissue, whereas, if the operation is undertaken later in life, the parts, not fully developed through non-use, cannot so easily be made to subserve the same purpose as tissues which develop through natural employment. It is well known that muscular tissue is more perfectly developed through action.

8. The muscles of the velum cannot be normally employed so long as the palate remains cleft, hence they remain in a partially developed condition through life. By operating at an early age, these muscles are brought into use and their development is proportional to other tissues.

[1] While it is very advantageous to operate at this early age, the bones can be united much later in life, provided they are moved by the slow process as practiced by the orthodontist.

[2] See opinions of authorities, page 134.

9. As a consequence of early operation, the nose is straightened and there is much less deformity than is the case in a later one, as all the tissues, bony as well as soft, develop naturally and according to accepted types.

10. When the palatal processes of the maxillæ are united, it will be observed that the bones in the development of the alveolar process of the upper jaw assume a form nearly or quite normal, and when the teeth are erupted they will occlude properly with the lower ones, or nearly so. We restore in *early infancy* the normal relations of the maxillæ by moving them together and holding them there until they unite.

11. The most beneficial result of the early operation is that it permits the normal development of the function of speech. Notwithstanding the fact that the surgical operation on an older child or an adult may produce a good palate in all its anatomical parts, the patient has acquired faulty habits of speech which have become so fixed that special training in phonation will be required to overcome them. In all cases of deferred operations, the patient should be placed, as soon as practicable after the operation, under the instruction of a speech specialist.

12. While realizing there would be a great advantage in closing the entire palate in one operation, experience has shown that the best results are secured in overcoming this deformity by operating in early infancy, first upon the bones and as soon thereafter as expedient upon the lip and finally, when the child is from 16 to 22 months old, upon the soft palate. By so doing normality is produced in all the parts.

13. The child operated on in early infancy will be better nourished following the operation and its general physical condition will improve rapidly.

14. In conclusion, it may be wise to point out the fallacy of operating on the cleft lip before uniting the bones and to show the logic of reversing the sequence. In cases of complete cleft of the hard palate accompanied by cleft lip, either single or double, the *lip must not be operated upon first.* We cannot, without great difficulty, close the cleft of the bones by transfixing them and secure immediate union *after* the cleft lip is closed.

When invited by Prof. Dr. August Bier of Berlin to operate on a young infant in the Hospital of the University of Berlin to demonstrate my method of approximating the bones in a cleft of the hard palate, a patient having a complete cleft was not obtainable. However, one was presented, for whom the cleft lip had been closed. I was requested to bring the bones in contact in this case. I did so, but the operation was performed with great difficulty since the bones were not as easy of access as they would have been if the lip had remained open. Nevertheless Prof. Warnekros reported to me that the operation was entirely successful.

As a rule, surgeons operate on cleft lip before closing the palate. The deformity is so conspicuous and distressing to parents that the operation is made in compliance with their wishes and to relieve their embarrassment. Three or four years later the operation on the palate is performed. Such a procedure might be likened to half closing a door and then attempting to carry a piano through it. We need the open door because we have a great deal to pass through it. We need, for the transfixing of the bones, all the space the open lip affords. The lip therefore *should not be closed until the bones are first united.* From one to three months after the bones are united, the lip may be operated upon. The closure of the lip does not materially interfere with the work on the soft palate.

The Late Results of Cleft Palate Operations.—In a paper read before the Clinical Congress of Surgeons of North America, in London, July, 1914, I said:

"I have brought from America three patients to exhibit to you their powers of phonation. It is an easy matter to make declarations as to the ability of patients to speak, following cleft palate operations. I do not intend to dwell for any length of time on this phase of the subject. The patients will speak to you themselves and it will remain for you to determine whether the result of the work done, according to my own methods, has been successful, and whether the object desired, in securing for the patients perfect speech, has been attained. The patients were operated on at different ages.

The first one was thirty years of age when the operation was done. She wore an artificial palate for several years before I operated. I have it here. You will observe that this was a very broad cleft, the kind that many class as inoperable. This cleft was closed without making a lateral incision. As I remarked in my paper, I regard these incisions as absolutely unnecessary for the purpose of closing the soft palate. To effect a union and secure a soft, flexible, useful palate, the tissues should be elevated, wire tension sutures adjusted and fixed upon lead plates.

You will observe that the palate is soft, flexible, and unmarked by scar tissue, which almost always follows when lateral incisions are made, and that it reaches back to the posterior pharyngeal wall. You will also note that her articulation is perfect. She speaks so distinctly that the most critical observer cannot detect the slightest defect in her voice. This, however, does not always follow an operation which yields the same result as in this case, so far as the operation itself is concerned. Many times where the operation has given equally good results the patient must be taught how to use the lips, the tongue—in fact, all the parts that enter into the formation of speech.

You will notice that all I have claimed regarding the operation for adults is demonstrated to be true in what Miss Miller has said in regard to perfect speech. I am satisfied that such results, provided the palate is not mutilated by the formation of scar tissue, can be secured in nearly all cases, if the patient is taught the mastery of the vocal organs. It only shows that one who is determined to overcome the habits which were acquired in infancy, and which have persisted through youth and early man- or womanhood, may succeed in speaking perfectly.

The next patient was operated on when nine months of age. She speaks English, French, and German. Her articulation is absolutely perfect. Her command of these languages is such that no one would suspect that she ever had a cleft palate. The young lady feels that she escaped the acquiring of defective speech because she was operated on before she was old enough to begin to talk.

The third patient was operated on when three months old. In his case there was a broad cleft of the entire palate with cleft lip, and the nose was deflected to the side opposite the cleft. On examination you will see that his dental arch is so well formed that one would scarcely realize he had had a cleft lip, and you will see that he has normal nostrils and his nose is straight. He also has normal speech. It would be hard to convince the mother of this boy that it would be wise to defer operation for cleft palate until a child is old enough to talk. His teeth occlude well. He has but one tooth absent, and that is the lateral on the side of the cleft, which never erupted. As you know, this tooth is often absent in cleft palate patients. If present, it is so much diverted from its proper position that it has little usefulness. This little boy is now eleven years old; he has made excellent progress in school, and he is one of the best informed boys of his age that I have ever met.

In answer to a question that has been asked regarding the disturbing of teeth in moving these parts together, I would say that in my earlier experience I did disturb teeth in carrying sutures through. I later found that careful manipulation when the point of the needle came in contact with the teeth would enable the operator to carry the needle between the teeth and by so doing, avoid disturbing them."

INSTRUMENTS USED IN CLEFT PALATE OPERATIONS

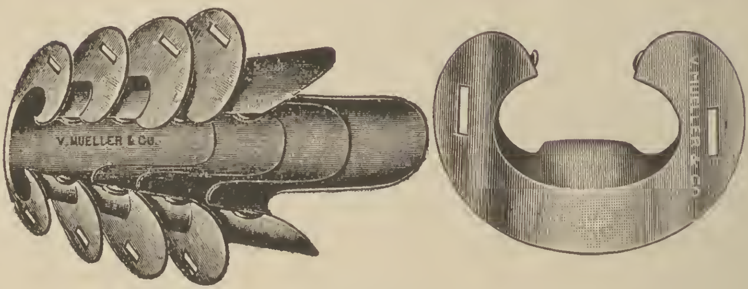


FIG. 357.—Two views of the author's oral speculum. This speculum will give an excellent view of the mouth and the field of the operation.

FIG. 358.—Detachable portable handle is of value in many cases to hold the speculum in place by the anæsthetist. Besides it holds up the chin which is of great assistance.

FIG. 359.—Author's Oral Speculum in Position. The anesthetist holds the speculum in position with a U-shaped handle. It is not only held in place but is of great assistance to the anesthetist as it keeps the patient's chin elevated.

Fig. 360.—Author's Wire Speculum.

Fig. 361.—Speculum in Position.

Figs. 360 and 361.—Author's wire speculum devised to give the operator a more extended view of the entire oral cavity. Especially convenient for the laryngologist.

Fig. 362.—Thin-bladed bistoury with long handle for fine dissection.

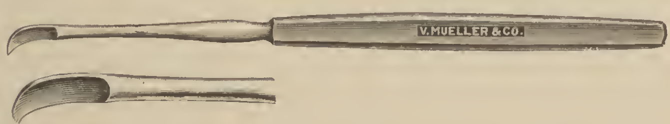


Fig. 363.—Curved bistoury sometimes used in repairing holes in the palate.

Fig. 364.—Angular bistoury with a double edge used in repairing holes in the palate.

Fig. 365.—Knife used to freshen the edges of the soft palate.

Fig. 366.—Bard-Parker knife used in cleft lip work. The ordinary handle is used for cleft lip work but a special long handle is made for palate work.

Fig. 367.—Long handled Bard-Parker knife.

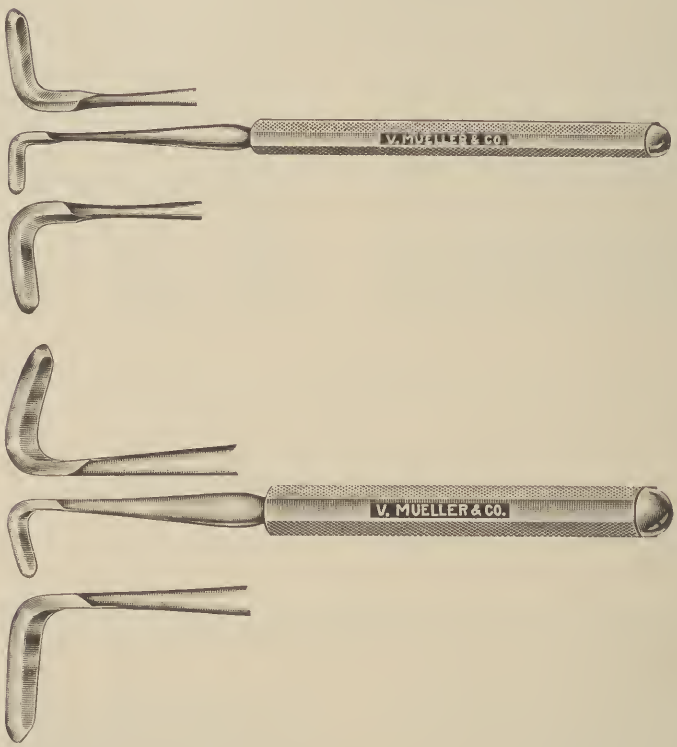


Fig. 368.—The author's curved periosteotomes for dividing and elevating the periosteum from the hard palate. They are made of different sizes and angles. The smaller size is used in children and the large size in adults. I have found the longer handles preferable. This periosteotome is extensively used by the general surgeon.

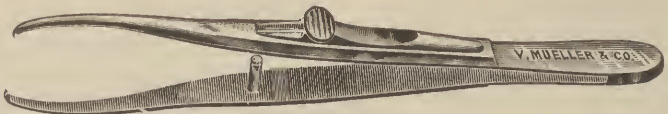


Fig. 369.—The author's modification of the English tongue forceps. When the speculum is in position, this forceps by its weight will hold the tongue out of the field of operation.

Fig. 370.—The author's long delicately pointed forceps for removing sutures.

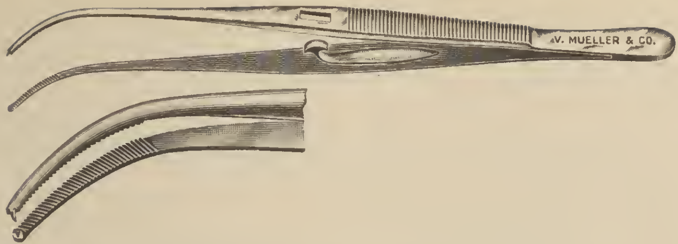


FIG. 371.—Long curved forceps used for sponging, grasping tissue, handling sutures, etc.

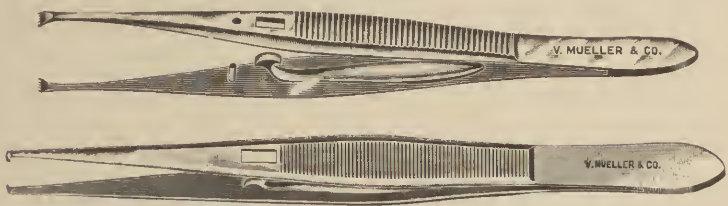


FIG. 372.—Self-retaining tissue forceps used in lip surgery.

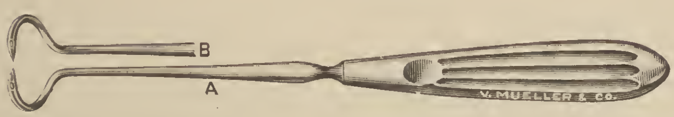


FIG. 373.—Small curved needles used for placing pilot sutures in operations on soft palate.

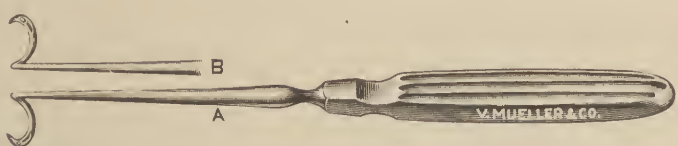


FIG. 374.—Deschamp's needles used for passing pilot sutures through the soft palate.

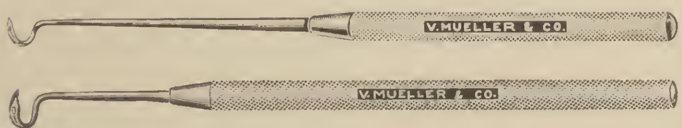


FIG. 375.—Small needles used to place horse-hair sutures in anterior part of fissure of palate.

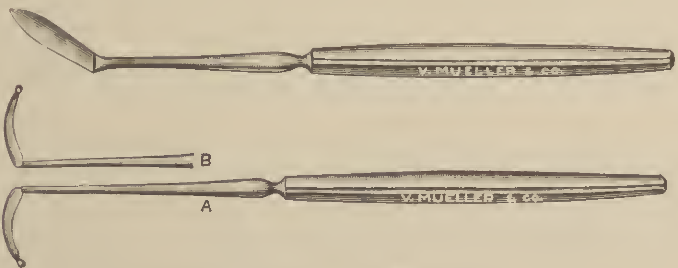


FIG. 376.—Angular knives used for Atresia Palati operations.

Fig. 377.—Needle used to pass pilot sutures beneath the soft parts. Note eye in point.

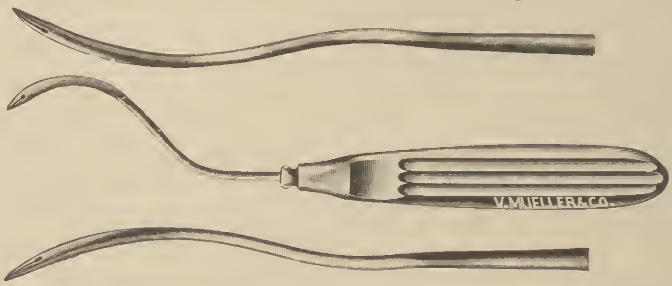


Fig. 378.—The author's strong needles used in the introduction of pilot sutures through the bones preliminary to passing the wire sutures.

Fig. 379.—New steel drill used to make opening through bones for passage of needle in cleft-palate work in infants.

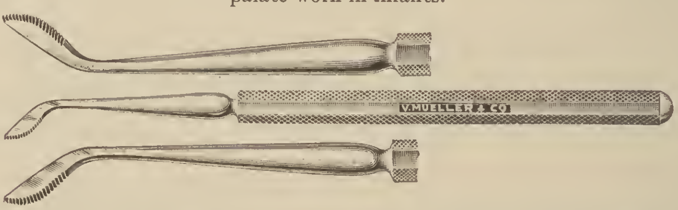


Fig. 380.—Scarifying instrument used to roughen the freshened edges of the bone and soft parts in cleft-palate work.

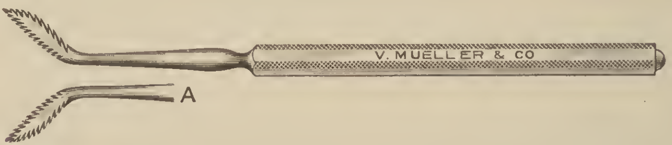


Fig. 381.—Scarifying instrument, corrugated on both sides, especially desirable in freshening surfaces of small openings.

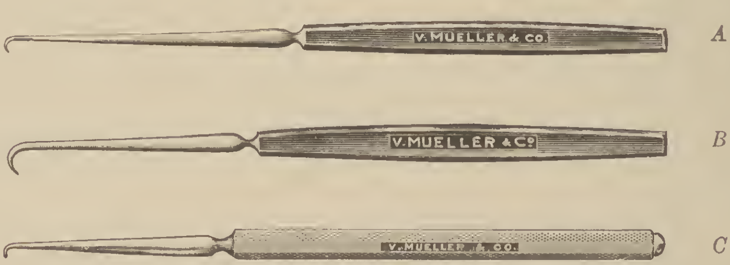


Fig. 382.—Tenaculæ of different sizes used in palate and lip work. *A* has an extremely fine point; *B* has a heavier point; *C* has a right angle dull point and is designed for changing the position of the lead plates after they have been adjusted.

FIG. 383.—Punch used for making holes in lead plates.

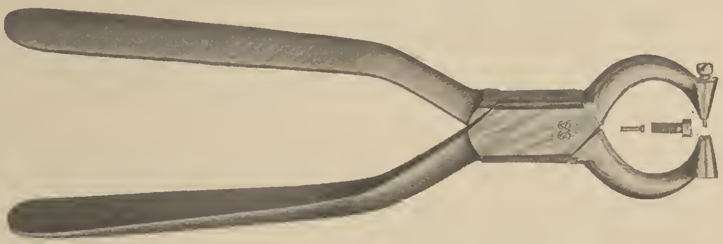


FIG. 384.—Punch for making the holes in the lead plates.

FIG. 385.—Long-handled, heavy-bladed scissors used in cutting wires.

FIG. 386.—Long-handled, thin-bladed scissors used in cutting horse-hair and silk sutures.

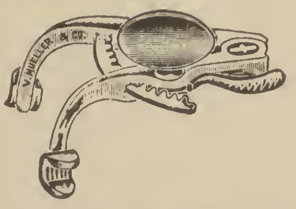


FIG. 387.—Ferguson's mouth gag.

FIG. 388.—Author's Modification of Ferguson Mouth-gag. The only difference between this and the original Ferguson mouth-gag is that the beaks close together and it may be easily placed between the teeth, when the turning of the screw will open it and give a view of the patient's mouth. This change was devised so that the instrument might be carried in the hospital from place to place, sterilized in solution and used to open and examine the mouths of children.

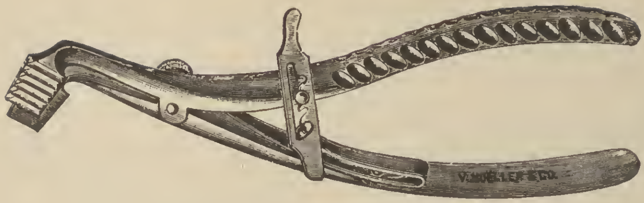


FIG. 389.—Heister's mouth gag.

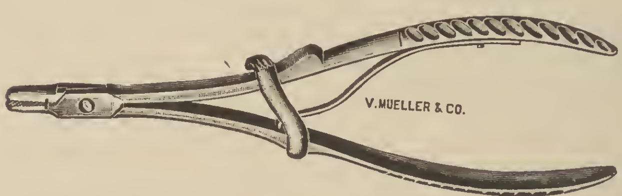


FIG. 390.—Old fashioned needle holder used as a wire twister.

FIG. 391.—Brophy-Truax needle holder.

FIG. 392.—Chisel used to bend the wire on the lead plates.

FIG. 393.—Hagedorn needles, Nos. 1 and 2, for suturing the skin and mucous membranes.

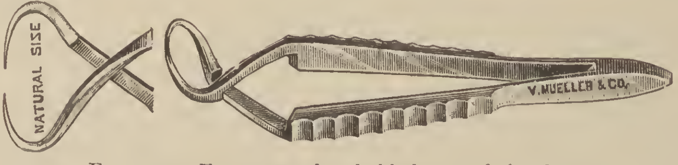


FIG. 394.—Forceps used to hold the towels in place.

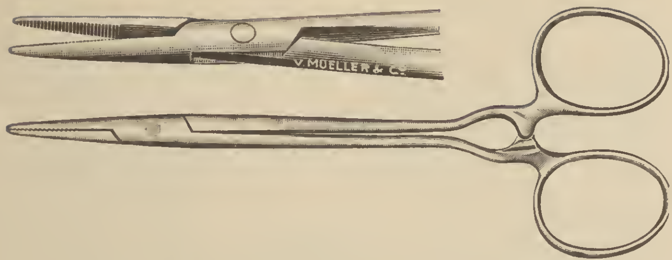


FIG. 395.—Mosquito hemostatic forceps used in lip work.

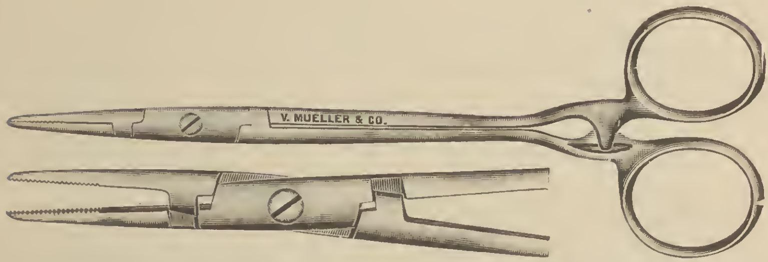


FIG. 396.—Author's fine-pointed, long-handled, hemostatic forceps. The points are held accurately together by the double guides. The shanks are long and narrow so the forceps will not take up much room in the mouth.

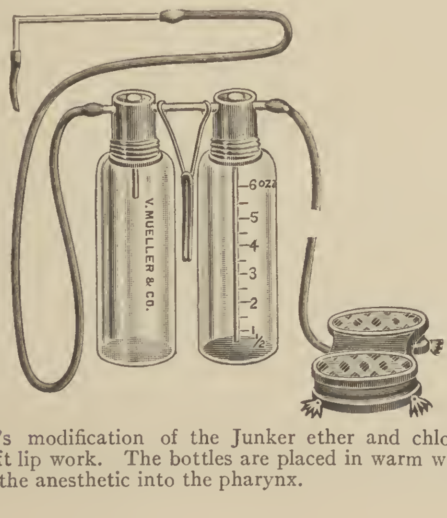


FIG. 397.—Author's modification of the Junker ether and chloroform vaporizer used in cleft-palate and cleft lip work. The bottles are placed in warm water when ether is used. The foot pump forces the anesthetic into the pharynx.

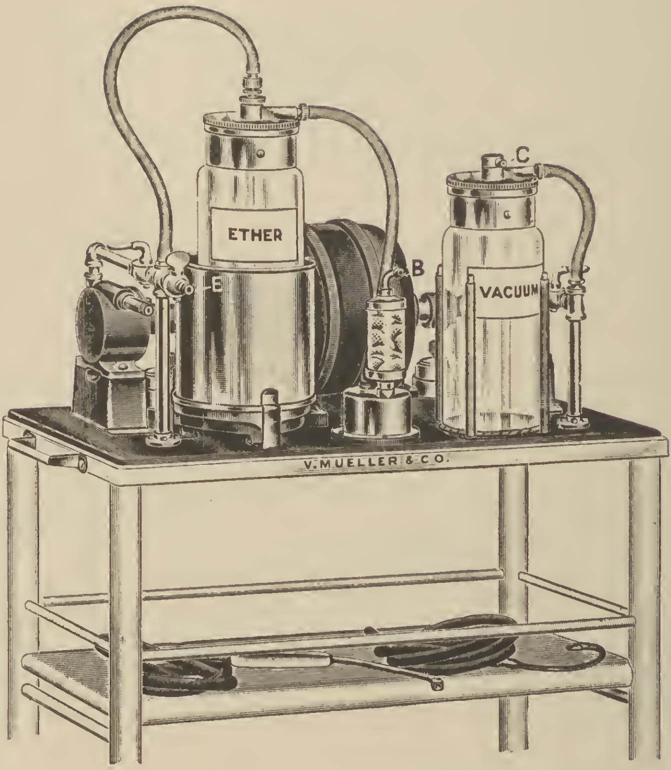


Fig. 398.—Electric ether inhaler and pump.

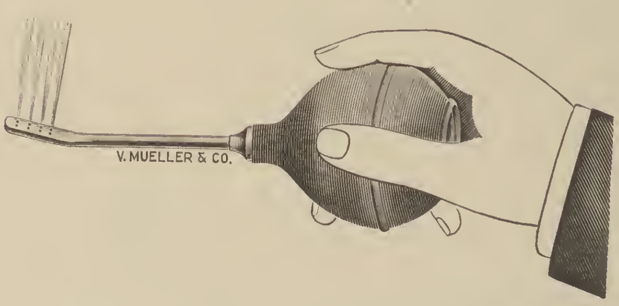


Fig. 399.—The Woolley syringe used in the after-treatment of cleft palate. The boric solution passes through the openings in the point with great force, but not in sufficient volume to injure the tissues. A minimum amount of solution is used.

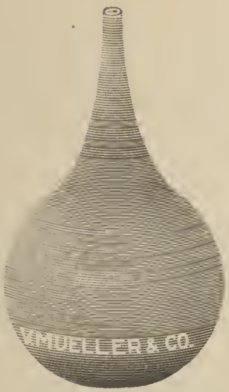


FIG. 400.—Soft rubber ear syringe used to flush the mouth and nose.

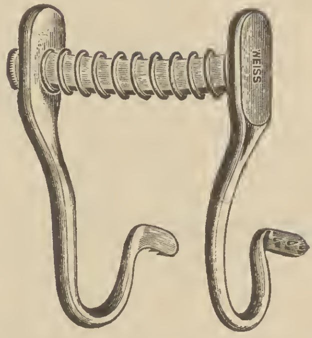


FIG. 401. –Mouth gag. (*Lane.*)

FIG. 402.—Lane's mouth gag. (*Lane.*)

Lane's Operation.—Lane's operative procedures depend upon the type of cleft to be repaired. He advises operations in early infancy.

Type A.—The cleft in the hard palate is unilateral. The septum is continuous with the hard palate on one side. The alveolus and the soft palate are also cleft. The essentials of the operative procedures are as indicated in Figs. 405 and 406.

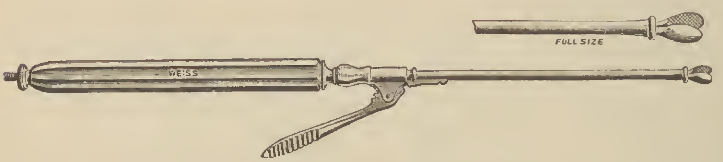


FIG. 403.—Lane's needle holder. (*Lane.*)

FIG. 404.—Needles. (*Lane.*)

Step 1.—Incision through the mucoperiosteum to the bone, 7-5-6-8. Reflection of flap.

Step 2.—Division of mucosa along posterior edge of soft palate, 4-3. Continuation of incision to posterior border of horizontal plates of palate bones, 3-2, thence forward to 1 and across the alveolus, 1-9. Reflection of flap 2-3-4.

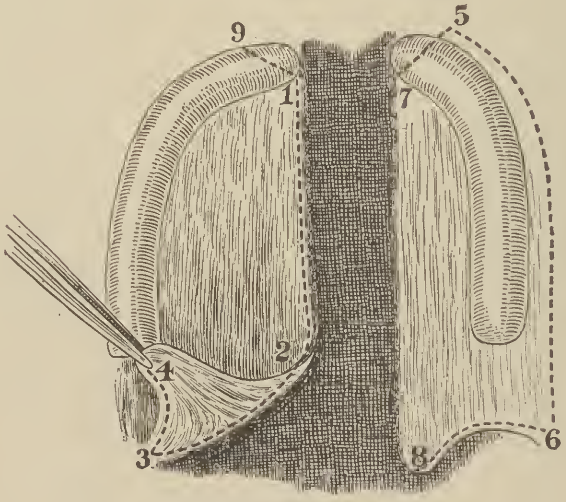


FIG. 405.—Lane's uranoplasty. (*Binnie.*)

Step 3.—Fixation of flap 7-5-6-8 into position 5-7-8-6 with epithelial surface toward the nose, and tucked well under flap 9-1-2-3-4 by two rows of fine sutures.

Type B.—Wide cleft, septum not attached to palate, alveolus not cleft.

Step 1.—Make flap 1-2-3 as in Type A.

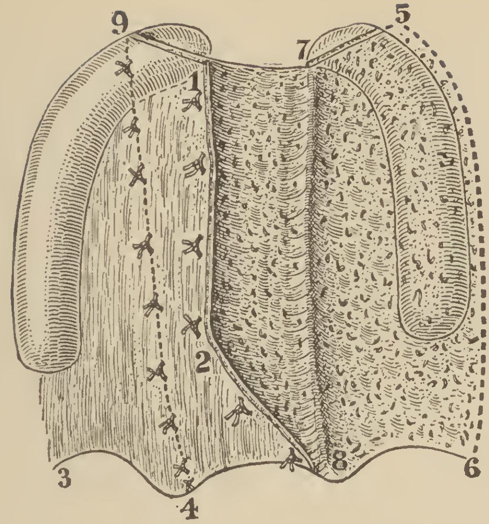


FIG. 406.—Lane's uranoplasty. (*Binnie.*)

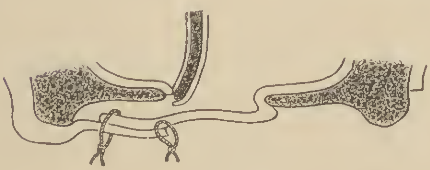


FIG. 407.—Lane's uranoplasty. (*Binnie.*)

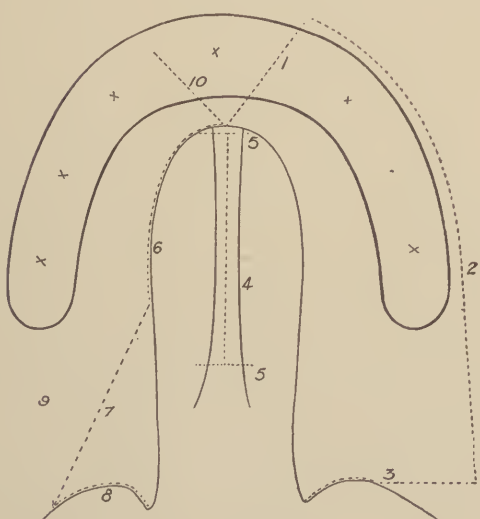


FIG. 408.—(*Lane.*)

Step 2.—Incision 6 through mucoperiosteum along edge of cleft. Incision 7-8 on nasal surface and reflect flap of mucosa as in Type A. Separate mucoperiosteum from hard palate.

Step 3.—Turn flap 1-2-3 over and tuck free edge of this flap well under flap 10-6-7-8.

Step 4.—Suture edge of flap 1-2-3 to base of flap 10-6-7-8. Suture edge of flap 10-6-7-8 to raw surface of 1-2-3.

Type C.—Double cleft palate. Premaxillary bone (P, M, Fig. 410) well in front of the alveolar arch and fixed to the under surface of the nose; the mesial segment (L) of lip is fixed to the anterior surface of the premax-

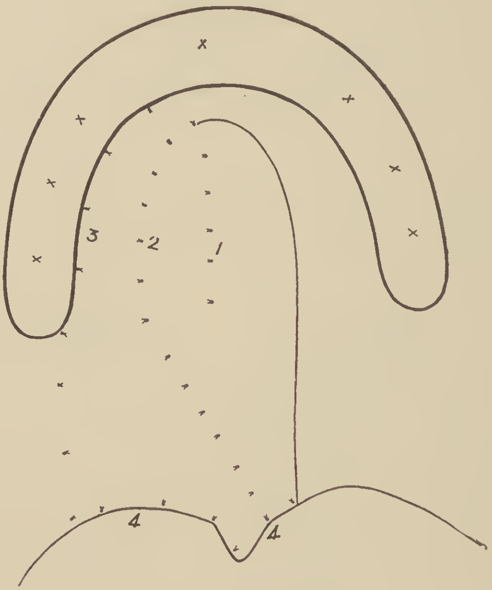


FIG. 409.—(*Lane.*)

illa. Operation by means of reflected and pivoting flaps. (The following description is in Mr. Lane's own words.)

"The reflected flap is obtained by an incision extending from 1 along the outer aspect of the alveolus, through 2, and on to 3, when it bends inward along the free margin of the soft palate to the uvula 4. The pivoting flap is obtained by an incision from 5, along the outer aspect of the alveolus, through 6, along the margin of the cleft in the hard palate from 7 to 8, along the upper surface of the soft palate 9, and then to 10.

"The area of mucous membrane corresponding to the triangle 8, 9 and 10, is raised and reflected inward. The area of muco-periosteum included in 5, 6, 7 and 8 is raised from the subjacent bone, except at the point of entry of the posterior palatine vessles and nerves, which form the pivot

on which this flap rotates. The mucous membrane is stripped from the premaxilla and from the free edge of the septum in the manner indicated by the dotted lines, showing incisions in the diagram.

"Large flaps are cut from the portions of lip forming the edges of the cleft, and great care is taken that they have an extensive attachment at their bases. The mucous membrane covering the lateral and lower aspects of the piece of lip lying in the front of the premaxilla is removed (L).

The reflected flap is first put in position; the mucous membrane, where it comes in contact with the under surface of the septum, having been rendered raw, is secured to it by sutures. The pivoting flap is then moved inward upon the reflected flap, to which it is united firmly by a

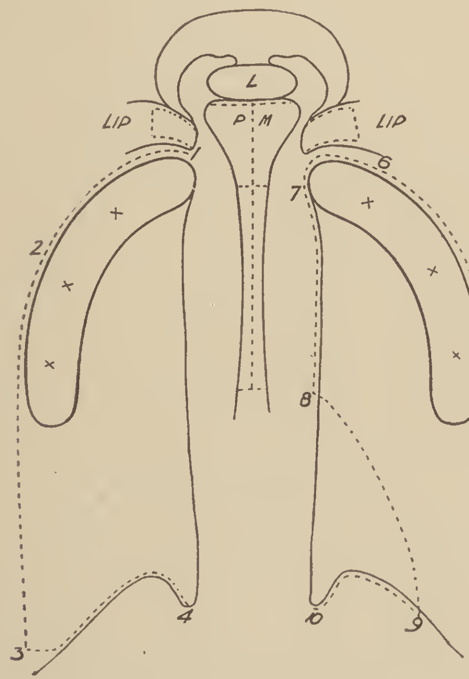


FIG. 410.—(*Lane.*)

double row of sutures. Finally the soft palate is closed in a similar manner. This is represented in Fig. 411.

"After this the triangular areas of muco-periosteum which were reflected from the premaxilla are fixed in position (see Fig. 412), where these are indicated by Y. The flaps from the lips shown as F, F are arranged with their raw surfaces upward. These are united to the raw surfaces of the flaps from the premaxilla and of the reflected flap, and are also sutured

by their margins to one another and to the free edge of the pivoting flap (see Fig. 413).

"Lastly, the ala of the nose is cut away from the cheek on either side and is displaced inward where it is united by sutures to the septum, and is sewn to the cheek in its new position. This I have attempted to indicate in the same diagram. Having brought the edges of the lip into accurate position by means of separate sutures, two sutures of linen thread are passed in the manner indicated in Fig. 414. The needle perforates the lip from behind, and is made to re-enter the anterior aspect of the lip

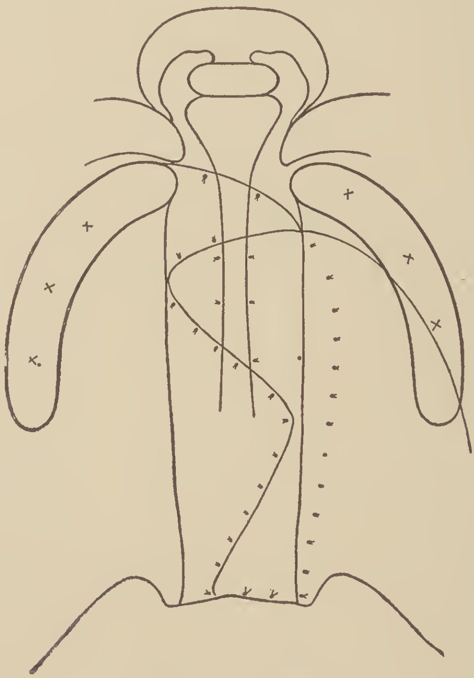


FIG. 411.—(*Lane.*)

through the same hole, and after traversing the lip transversely it again emerges and enters through the same hole, the needle passing directly backward through the lip. When this thread is made taut and tied the opposing raw surfaces of lip are held in accurate position, and no scar whatever results from the presence of these deep sutures, which can be readily removed when they have served their purpose. In Fig. 414 only one cleft in the lip is represented."

Type D.—Wide cleft of soft palate.

Step 1.—Reflect the flap 1, 5, 6, 7, 8 (Fig. 415) with its base at the edge of the cleft.

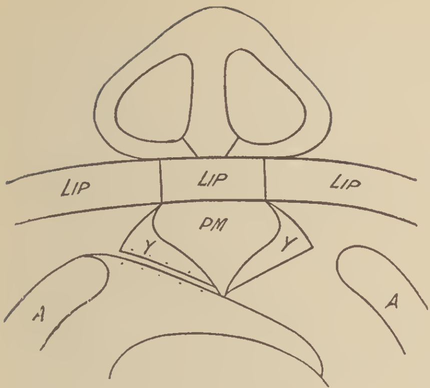


FIG. 412.—(*Lane.*)

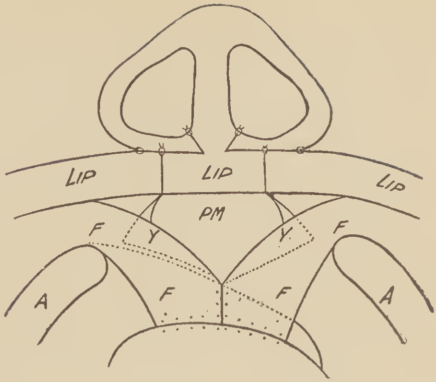


FIG. 413.—(*Lane.*)

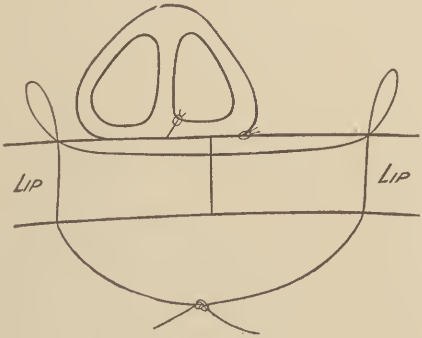


FIG. 414.—(*Lane.*)

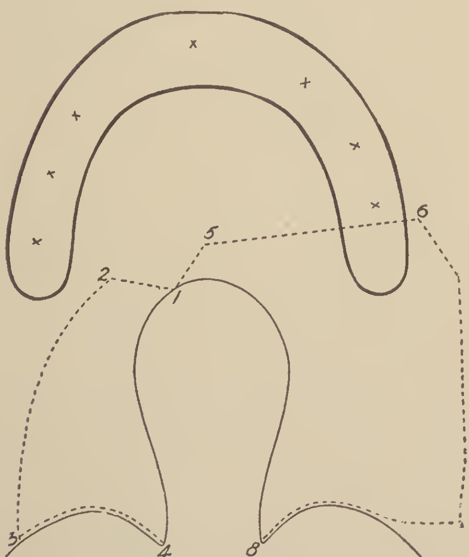


FIG. 415.—(*Lane.*)

The flap consists partly of muco-periosteum from the hard palate and alveolus and mostly of mucous membrane from the soft palate and cheek. The flap must be large enough to easily cover the defect. Do not injure the musculature of the soft palate.

Step 2.—From the *nasal* surface of the soft palate on the opposite side of the cleft reflect the flap 1, 2, 3, 4 with its base at the edge of the cleft.

Step 3.—Suture the two flaps together one over the other in an overlapping fashion (Fig. 416).

It will be observed in Lane's operations that the space between the separated bones, or the cleft, is bridged over by tissues, the superior surface of which is mucosa. Now if the periosteum were lifted on both sides and

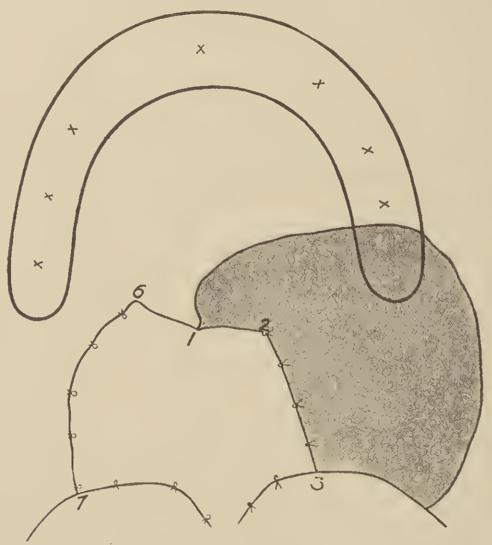


FIG. 416.—(*Lane.*)

brought in contact so that the superior freshened surfaces were made of periosteum, we would then have as a sequel, by reason of its osteogenetic powers, a layer of bone developed. In the management of such cases, I hold the view that *the maxillary bones which are separated should be moved in contact in very early infancy before ossification is so far advanced as to prevent bending and easily moving them into proximity. When we have placed the edges of the cleft bones in contact, we have brought the parts into their normal condition as far as the breadth of the jaw and the relation of the bones to each other is concerned.* The theory advanced that the moving of the separated bones into contact will abnormally contract the upper jaw has not been established by clinical experiences. It has been exploited by those who have supposed that the space forming the cleft is the result of

arrest of development of the palatal tissues. The assumption has been that the moving of these parts together would produce an abnormally narrow arch. Such statements are theoretical. They are not based on post-operative observations.

It has been my privilege to witness the work of Lane. While he succeeds in closing the cleft, it would seem that the open fissure is covered only by the soft parts with no prospect of bony union, whereas bringing the edges of the bone into contact, after my own method of practice, *insures the union of the plates of the hard palate, thus establishing a substantial bony arch.*

Blair's Operation.—The operation consists of passing silver wires through the maxillary bones from one bucco-alveolar cul-de-sac to the

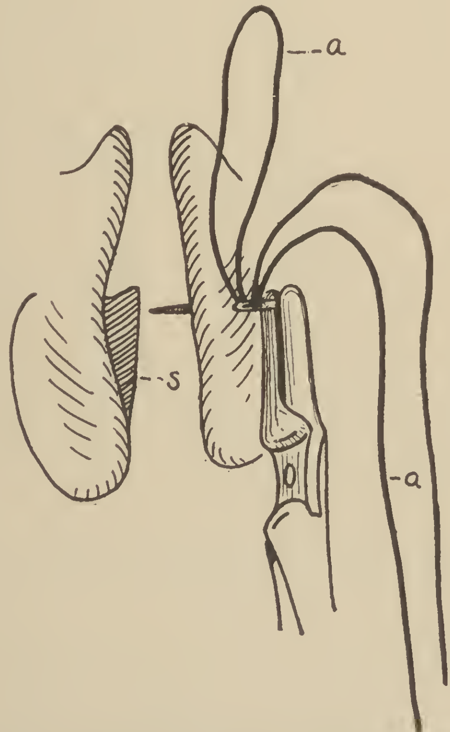


FIG. 417.—Approximating the maxillæ by through-and-through wires. First step, placing a heavy silk loop through one maxilla posteriorly. (*Blair.*)

other. By twisting the wire over two lead plates and by lateral pressure on the bones and, when needed, by cutting the outer wall of the orbit through a small mucous incision, the anterior end of the cleft is obliterated and the posterior part is narrowed. If expedient, a muco-periosteal flap

is raised from the hard palate on both sides and united over the anterior third of the cleft, the sutures being inserted before the anterior parts of the maxillæ are completely approximated.

Blair uses a ⅝-circle reverse-eye Hagedorn needle of two sizes to pass the pilot sutures through the bones. The needle passes from the upper buccal fornix through the jaw-bone along the floor of the orbit and into the cleft. Forceful approximation of the maxillæ by means of forceps

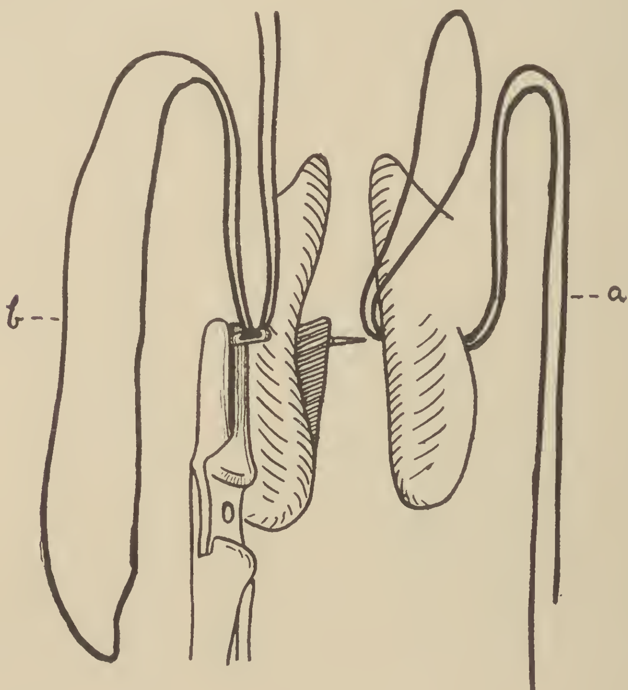


Fig. 418.—Approximating the maxillæ by through-and-through wires. Second step, placing a heavy silk loop through the other maxilla posteriorly. (*Blair.*)

is used at this time in very young infants with single clefts and a single wire suture passed through the anterior part of the jaws bringing it around in front of the intermaxillary bone without the lead plate.

Blair's order of procedure is to close the lip at the first operation and gives the following reasons:

1. Nasal breathing established earlier.

2. Eliminates the necessity of a second operation within a few weeks after the first one, which the child may not be able to undergo.

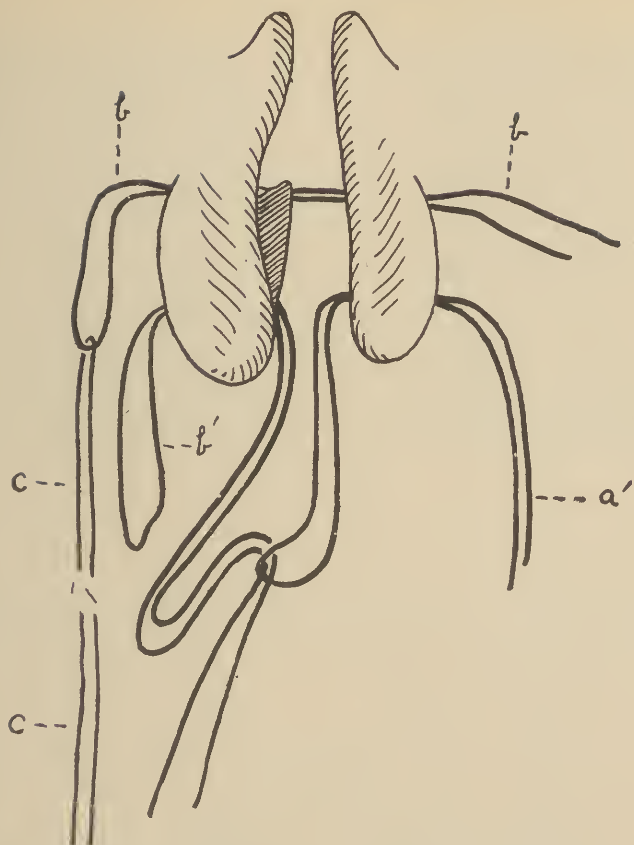


FIG. 419.—Approximating the maxillæ by through-and-through wires. Anteriorly is shown how one loop (a') is passed over the ends of the second loop (b'). By drawing on the (a') loop, the (b') loop is made to traverse both maxillæ. (b) shows loop in position with wire; (c) ready to be drawn in place. (*Blair.*)

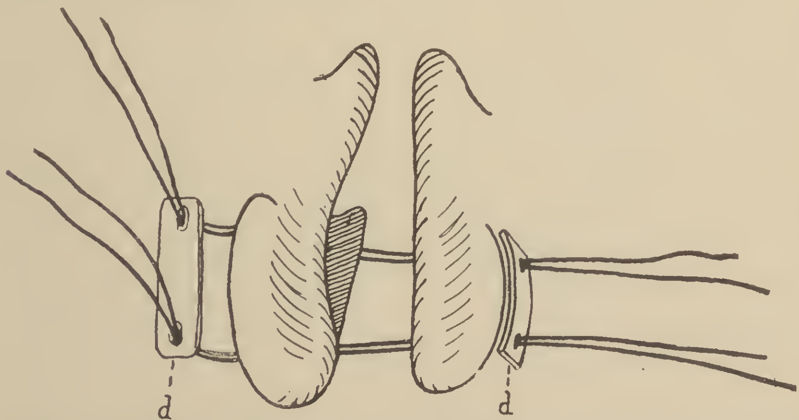


FIG. 420.—Approximation of the maxillæ by through-and-through wires. Showing two double wires in position threaded at each end on a lead plate (d). If single wires are used, No. 20 is the proper size, while No. 22 or 24 is used double. (*Blair.*)

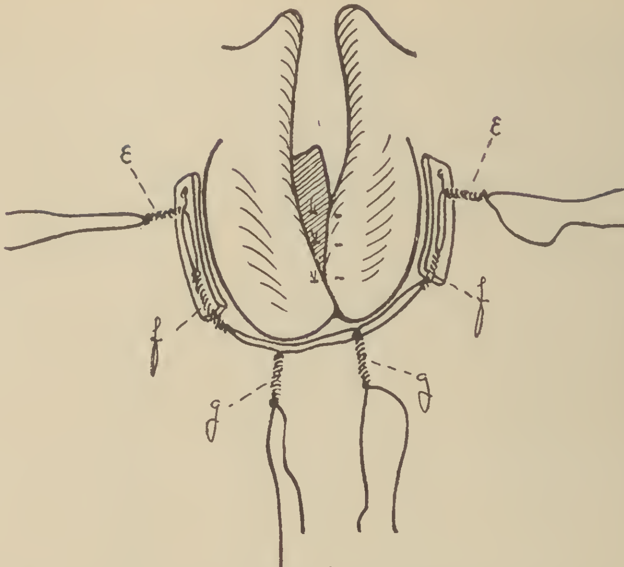


FIG. 421.—Approximation of the maxillæ by through-and-through wires. This shows the maxillæ approximated. This is done by pressing the bones together and taking up the slack by twisting appropriate wires. The approximation of the alveolar part of the cleft is made more sure by bringing two of the wires around the intermaxillary bone and twisting them at (*g*, *g*). (*Blair.*)

FIG. 422.—The needle used in piercing the maxillæ is known as a 5/8-circle, reverse-eyed Hagedorn. Two sizes are used: one a circle the size of a nickel, the other the size of a quarter. Some of the broad cutting point is ground off. (*Blair.*)

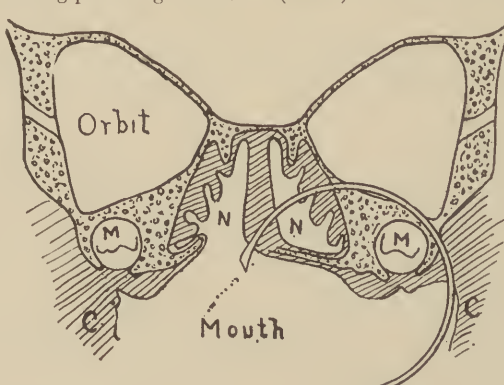


FIG. 423.—An accurate diagrammatic reproduction of a section of a frozen head of an infant with a single cleft of the palate. This illustrates how a 5/8-circle needle can be made to pass from the upper buccal fornix, through the jaw-bone, along the floor of the orbit and into the cleft. (*Blair.*)

FIG. 424.

FIG. 425.

FIG. 424.—Wide single cleft in a very young infant. Result of the Brophy operation shown in next figure.

FIG. 425.—Shows the result that may be obtained by the Brophy operation, in a very young infant. In doing this, the nasal passages should not be obstructed. Although this infant did well in every way, still drawing together the maxillæ to the extent here shown may produce nasal obstruction. (*Blair.*)

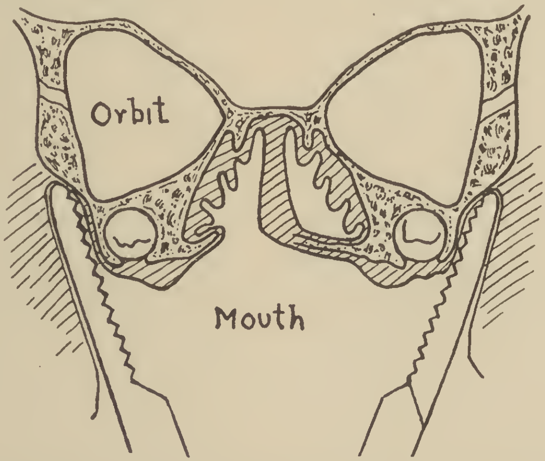


FIG. 426.—Showing position of the jaws of the forceps in forceful approximation of the maxillæ. (*Blair.*)

SECONDARY OPERATIONS ON THE PALATE

The most successful operators sometimes meet with failure in securing a union of the divided parts (Figs. 427 and 428). This failure may be partial or complete. The surgeon approximates the freshened edges of the fissure and, by the use of lead plates, holds the parts in quiet contact. With these plates, previously described and illustrated, he is able to maintain an approximation of the edges of the cleft, but the work of Nature cannot always be relied upon to effect the process of repair. The question

resolves itself into the behavior of wounds. The experienced surgeon realizes fully that in a wound immediate repair does not always take place. In some patients the repair of a wound is tardy, while in others the lips of the wound, though in contact, remain ununited for a considerable length of time and may refuse to heal. Such is the case occasionally in the closing of a cleft palate. The general condition of the patient is oftentimes responsible for partial or complete failure of union following these operations. The patient's physical condition, as has been stated, should be considered carefully prior to any operation.

When to Re-operate.—If either partial or complete failure of union of the palate follows an operation, it would be extremely unwise to operate again until after sufficient time has elapsed to enable the tissues to recover fully from the effects of the first operation. If there is failure of union throughout the entire length of the palate, from three to six months should

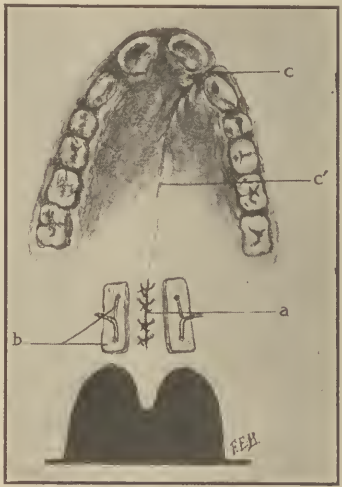


Fig. 427. Fig. 428.

Fig. 427.—*a*, Partial non-union of soft palate following repair; edges denuded. *b*, Lead plates and silver wire in position showing relation to opening. *c*, Cleft of hard palate closed by previous operation.

Fig. 428.—*a*, Opening in soft palate closed by horse-hair sutures after denudation of margins. *b*, Lead plates with silver wire sutures twisted to maintain approximation without tension. *c*, Cleft of the hard palate closed by previous operation.

be allowed to pass before another operation is attempted, when it will be necessary to repeat the first operation with such modifications as the condition of the parts may require. Among some of the most difficult operations on cleft palates are those following failure of union or the breaking down of tissues. As a result of making lateral incisions through the soft parts, a great mass of cicatricial tissue is sometimes encountered, the circulation of which is poor, and the union of the edges following freshening

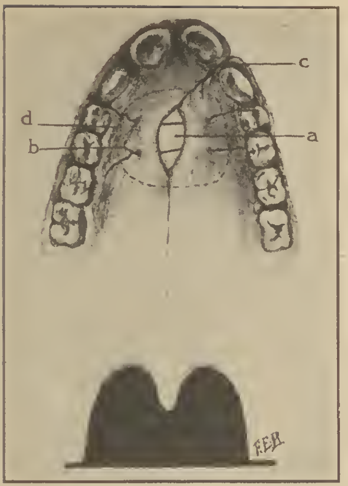


FIG. 429.

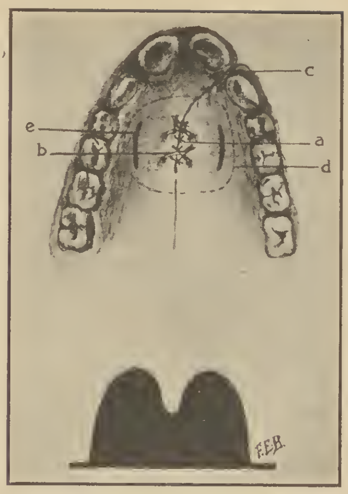


FIG. 430.

FIG. 429.—*a*, Opening in hard palate. *b*, Silver wire retention sutures in place. *d*, Area of periosteum elevated from the bone to prevent tension.

FIG. 430.—*a*, Opening in hard palate closed by horse-hair sutures following denudation of margins. *b*, Silver wire retention sutures twisted. *c*, Approximation of alveolar processes obtained by previous operation. *d*, Dotted line indicates area of soft parts and periosteum elevated to permit margins of opening to be approximated with least degree of tension. *e*, Indicates incisions through soft tissues; to be employed when tension warrants, further explained by Fig. 433.

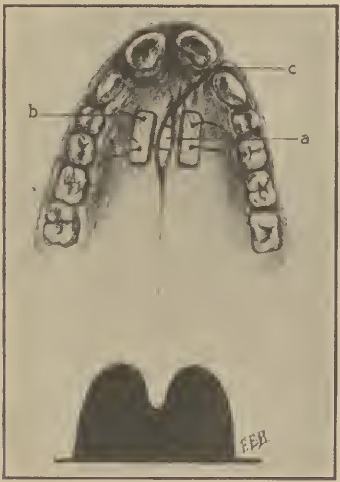


FIG. 431.

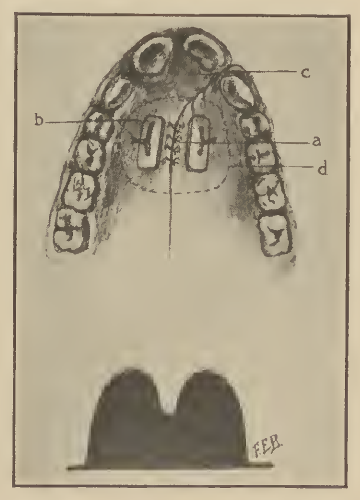


FIG. 432.

FIG. 431.—*a*, Opening in hard palate following repair, edges denuded. *b*, Silver wire and lead plates in position. *c*, Approximation of alveolar processes obtained by previous operation.

FIG. 432.—*a*, Opening in hard palate closed by horse-hair suture. *b*, Lead plates in position and silver wire retention sutures twisted. *c*, Approximation of alveolar processes obtained by previous operation. *d*, Dotted line indicates area of soft parts and periosteum elevated to prevent tension. Incisions may be employed as in Fig. 430 if tension persists.

and suturing is thereby rendered far more uncertain than it was at the first operation.

Repairing Small Openings.—In my earlier experience, if a small opening remained, I attempted, as soon as it was discovered, to close it by suturing —in most cases to my regret. If a small opening follows, the young surgeon is strongly inclined to attempt its closure before the tissues have recovered from the previous operation. I am satisfied such attempts, when the tissues are still congested, are not justifiable. Several weeks, or even months, should be allowed for the parts to recover their normal circulation and tonicity. A hole in the palate may vary from the size of a small sinus, which will admit only a small silver probe, to an opening as wide as the palate. The closing of a hole of this character may be accomplished

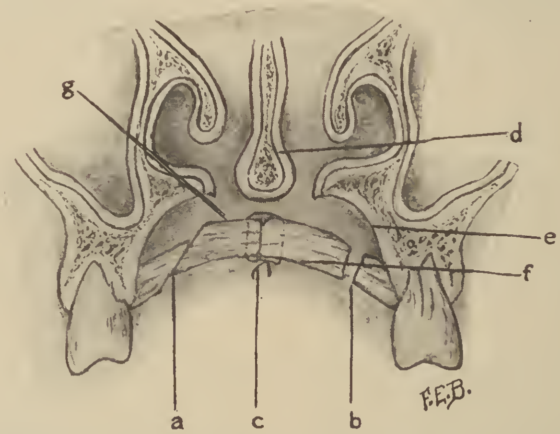


Fig. 433.—Sagittal section illustrating the technic of closing a large hole in the hard palate. The muco-periosteum has been lifted from the bone. *a*, Correct method of making incision through the soft parts. The incision is started near the border of the teeth and carried obliquely upward so that a large part of the freshened surfaces may be kept in contact. *b*, Incorrect incision. An incision made straight through the membranes is followed by separation of the soft tissues, thus retarding healing and sometimes results in failure of union. *c*, The opening closed by wire sutures. *d*, Vomer. *e*, Palatal process of the maxilla. *f*, Mucous surface. *g*, Periosteal surface. The artist should have made the incisions a little closer to the teeth, so as to avoid the blood vessels.

in several ways, the methods to be employed depending largely upon the size and character of the opening. If a small opening occurs in the soft palate it may be closed by scarifying the edges at the opening with instrument Fig. 381, or by suturing with horse-hair or silver wire; if the opening is of larger size in the soft parts, silver wire with lead plates may be used to secure tension upon the tissues (Figs. 427 and 428). A flap may be successfully employed. If small openings occur in the bone, the muco-periosteum should be raised with the periosteal elevators, the edges freshened and the parts sutured. The raising of the muco-periosteum will drop these parts low enough, oftentimes, to enable the freshened edges to be brought directly together without incisions (Figs. 429 to 432). If, however, the

edges will not meet without tension, oblique incisions are made to the bone close to the teeth which allows the edges of the opening to meet. These small repairs may be made very satisfactorily in adults under novocain anesthesia.

Repairing Large Openings in the Hard Palate.—In larger openings it becomes necessary to move the soft parts farther than their attachments will permit, which may be done as follows:

By lifting the muco-periosteum from the bone, freshening the edges of the opening and introducing silver wire sutures so as to bring the edges of the opening into as close proximity as possible. After this, incisions are made very close to the teeth and the muco-periosteum moved toward the median line by further twisting the wire sutures. Thus the edges can be brought into contact. These incisions should be so

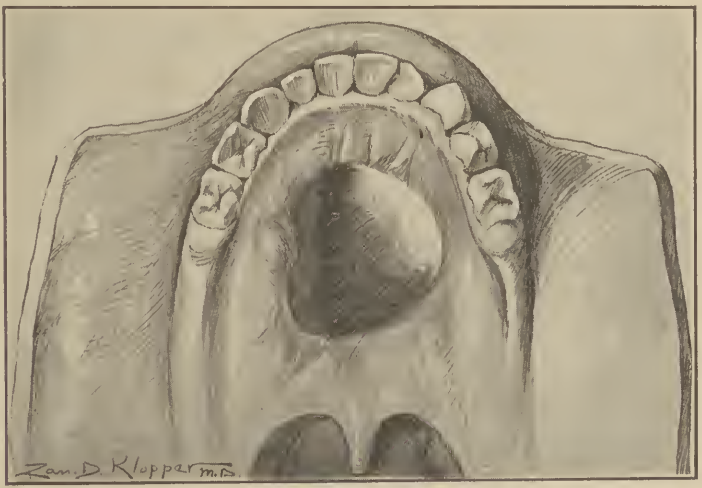


Fig. 434.—Drawing from plaster cast showing a large opening in the hard palate in a young child, the result of failure to secure a union following cleft palate operation.

made that the bone will not be entirely denuded of periosteum, as would be the case if the knife were carried straight through it. This can be obviated by making an oblique incision which starts close to the alveolar margin, carrying the incision upward and inward so as to bring the edge of the knife to the bone about one-fourth of an inch medially from the point of entrance (Fig. 433). It will be seen that the freshened surface of connective tissue on both sides of the incision will unite and close the aperture. The openings made by the side of the teeth should be lightly packed with iodoform gauze so as to prevent the passage of air and to promote the formation of granulation tissue along the line of incisions. The incisions made through the muco-periosteum at the border of the alveolar processes leave openings

which will soon close by the formation of granulation tissue and the palate at this particular location will not be impaired.

It must not be understood that these incisions are not in accord with my statements regarding incisions in the soft parts for the division of the

FIG. 435.—Deciduous molar teeth removed so as to provide for the making of flaps to close the opening.

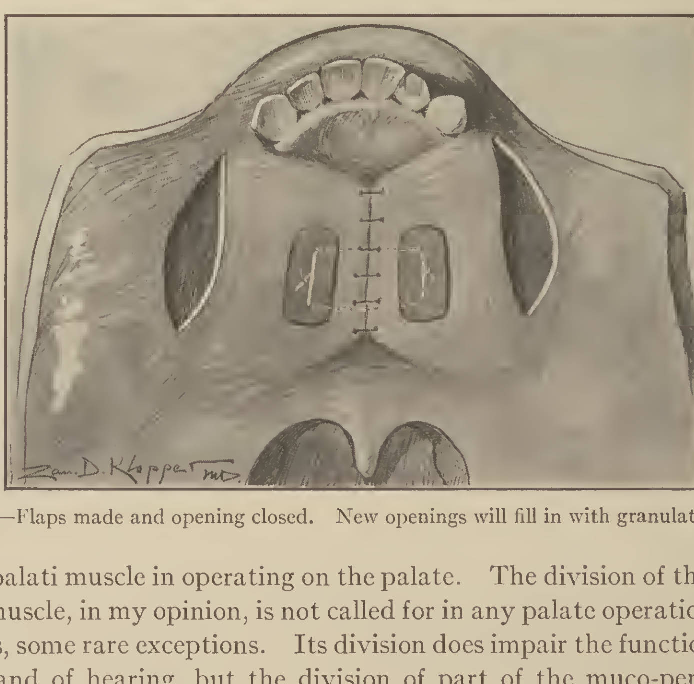


FIG. 436.—Flaps made and opening closed. New openings will fill in with granulation tissue.

tensor palati muscle in operating on the palate. The division of the tensor palati muscle, in my opinion, is not called for in any palate operation, with, perhaps, some rare exceptions. Its division does impair the function of the palate and of hearing, but the division of part of the muco-periosteum

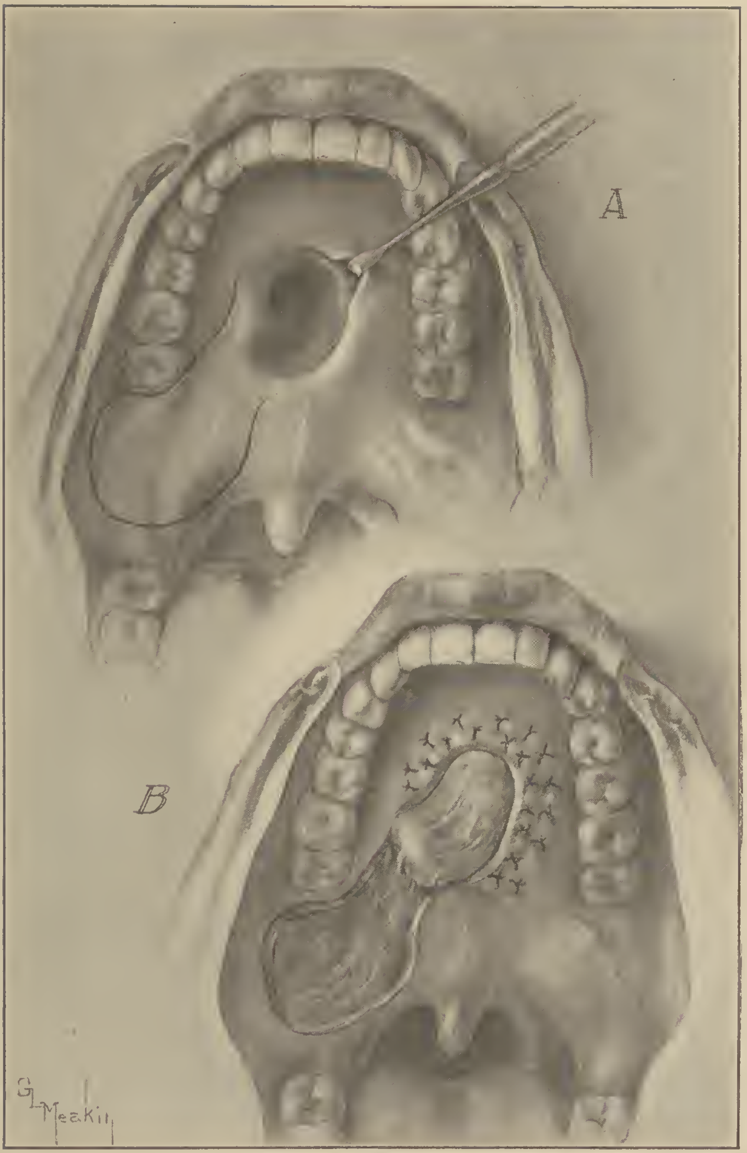


FIG. 437.—Exhibits the repair of a hole which had resisted many operations. The large flap that is outlined was taken up and carried over, quilted beneath the muco-periosteum which was denuded from the bone and stitched after the manner of Sir Arbuthnot Lane. This flap, in the case here illustrated, lived and made a very excellent closure of the opening. I have made these operations on many patients, nearly always with good results.

covering the hard palate cannot result in any injury since the hard palate is a solid, immovable arch and the formation of cicatricial tissue over its surfaces, therefore, does not interfere in any way with its function.

When large openings or holes remain in the hard palate in children following operation (Fig. 434), owing to failure of union, I have frequently extracted the upper deciduous molars on each side (Fig. 435). I have

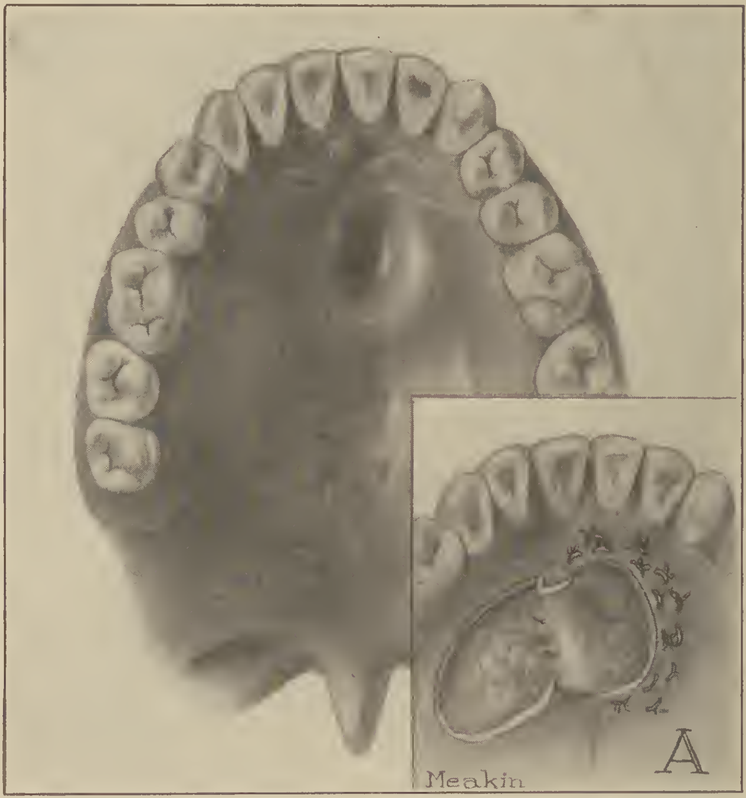


FIG. 438.—Exhibits a hole in the palate. Whether this is a post-operative hole or one due to trauma or disease, it interferes with phonation and calls for treatment. The success of the other operations of turning flaps prompted the making of this one which proved very satisfactory. I feel that in cases where there is little tissue between the teeth and the hole, that this method of procedure holds out to us the most promising results.

done this in children prior to the eruption of the first permanent molar teeth, which occurs about the sixth year. It is essential to wait until the sockets of the teeth have perfectly closed, a period of something like six months. Then an incision is made through the muco-periosteum, beginning at the palatal surface of the cuspid tooth, carrying the incision across the alveolar process, upward over the external alveolar plate and up upon the buccal mucous membrane, backward beyond the tuberosity

of the jaw and then inward toward the soft palate. This incision is made deep enough into the tissues of the cheek to enable the operator to carry away considerable of the muscular tissue. The parts are dissected away from the bone and we thus get a great quantity of tissue with which to close the opening (Fig. 436). The loss of the deciduous upper molar teeth, between the age of five and six years, is always to be regretted, but the removal of the deformity of the palate renders the procedure justifiable. It is needless to state that we would not remove these teeth except as a last resort.

Repairing Very Large Opening.—The majority of the post-operative openings of the hard palate, I regret to state, are not infrequently due to the methods still practised, namely, the chiseling of the bone and moving the palatal plates of the bones toward the median line for the purpose of approximating them and thus closing the cleft. The bones thus separated sometimes become necrotic, slough out and leave enormous openings in the palate. In other cases, the openings are due only to the failure of the tissues to unite following previous operations. In speaking of methods of dividing the bones according to Dieffenbach and Fergusson, Bryant comments thus: "Differences of opinion exist among competent authorities regarding the wisdom of this plan of practice, it being claimed that hemorrhage, sloughing, necrosis and septicemia are quite prominent factors in its history, especially in children of lessened vigor." I believe the practice of chiseling the palatal plates of the bones, and separating them from the alveolar processes with a view to closing cleft palate, is nearly obsolete.

ADVANTAGES OF THE USE OF LEAD PLATES AND SILVER WIRE SUTURES

First.—The sutures do not cut out, since the lead plates with wires passing through them, lie on the surface of the soft palate and, as the wires are tightened, the plates make tension on the soft parts, holding the edges of the fissure in quiet contact. Therefore, tension is made not alone by the sutures (which exert pressure on so limited a portion of the tissues), but also by the lead plates (which distribute the pressure over a larger area).

Second.—The lead plates serve as a splint, rendering the palate inflexible to a very great extent. The movements, which are almost constant, are very largely suspended. The active muscles are put out of use until the edges of the cleft unite. The twisted wires bent down over the plates furnish a most excellent protection to the palate, as they are uncomfortable to the touch of the tongue, yet do not lacerate nor abrade it. The contact of the tongue is not pleasant and this is very fortunate because the patient will keep the tongue away from the palate and allow it to heal without being disturbed. I regard the adjustment of devices

in the form of artificial palates and the like, as a means of protection to the sutures, as clumsy, unclean and wholly unnecessary. Having first devised lead plates as a means of approximating and holding the borders of the cleft in quiet contact, I am confident that better results can be secured by their use than by the employment of sutures alone.

Third.—With the silver sutures and lead plates in position, with the edges of the cleft approximated with horse-hair sutures, we at once see that *for the purpose of relieving tension, the making of lateral incisions through the tensor palati or any of the other palatal muscles, with all the resulting permanent injuries, is not necessary.*

Myotomy Unnecessary.—The myotomy method of operating was devised in 1844 by Sir William Fergusson of London. He recognized that the tension on the sutures was frequently followed by their cutting out and

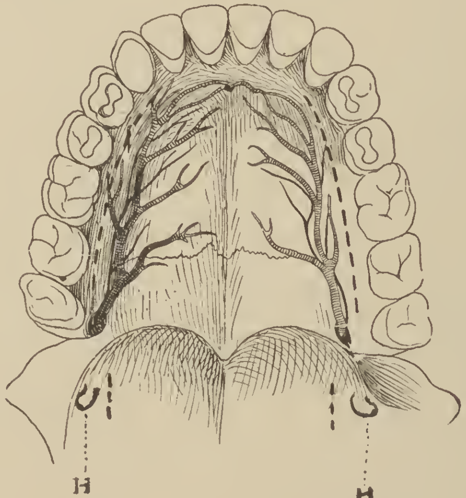


FIG. 439.—Showing the distribution of the posterior palatine and its anastomosis with the anterior palatine artery. The dotted lines show where incisions are made in closing large holes in the hard palate. (*Source unknown.*)

consequent failure of the approximated tissues to unite. To relieve this tension, Fergusson resorted to myotomy: dividing the levator palati, the palato-glossal and palato-pharyngeal muscles. It was found that Fergusson's operation was not so frequently followed by the sutures cutting out and, consequently, it became popular. In 1860, Dr. D. Hayes Agnew of Philadelphia, pointed out that the action of the tensor palati drew the newly approximated surfaces of the soft palate apart, causing the sutures to cut out and consequent failure of the operation. To relieve this tension, Dr. Agnew divided these muscles at their constricted parts, as they passed over the hamular process of the sphenoid bone, thus relaxing the ten-

sion upon the soft palate and causing the sutures to cut out less frequently. While the efforts of the distinguished surgeons named made it possible to avoid many of the failures resulting from the sutures cutting out and the edges of the segments separating, clinical experience extending over many years and a study of the palates of patients so treated[1] *convinces me that myotomy is not only unnecessary, but positively detrimental, as the function of the palate is permanently damaged thereby.*

EIGHT REASONS WHY LATERAL INCISIONS THROUGH THE SOFT PALATE SHOULD NOT BE MADE

Operations for the closure of the soft palate (staphylorrhaphy) should be performed in such a way as to leave the tissues in the most favorable condition for the performance of their normal functions. The surgeon must keep in mind the importance of producing for the patient not only a surgical success in bringing the divided tissues in contact and uniting them, but he must do his work in such a manner as to leave the parts, as far

FIG. 440.—Posterior view of palatal muscles together with the ascending palatine artery.

as possible, free from permanent defects so that his patient may acquire normal speech. To do this, *he must not resort to myotomy nor the making of lateral incisions in the soft palate for the following reasons:*

1. The tensor palati muscle arises from the scaphoid fossa of the sphenoid bone and the cartilaginous portion of the Eustachian tube. It is directed downward, then reflected over the hamular process and passes

[1] See Figs. 259 and 345.

forward to be inserted into the anterior surface of the soft palate (Fig. 440). The action of the tensor palati muscle is to render the soft palate tense and to dilate the pharyngeal orifice of the Eustachian tube. The division of this muscle, as it passes over the hamular process of the sphenoid bone, causes unnecessary hemorrhage.

2. The wound creates a new field for infection and the tissues are more likely to break down.

3. Once completely divided where it crosses the hamular process of the sphenoid bone, the muscle retracts to such an extent that it is never reunited, consequently the palate loses the function of one of its most important parts.

FIG. 441.—Tripartite cleft palate showing both central and right lateral incisoı alveoli. Left lateral incisor probably developed in the maxilla. (*Specimen* 206, *Royal College of Surgeons, London.*)

4. It must have been observed by all operators of considerable experience that when the tension of the palate is relieved by dividing the tensor palati muscle, defective hearing follows. This is due to the destruction of the continuity of the tensor palati muscle and consequent failure of the pharyngeal opening of the Eustachian tube to dilate normally.

5. In making these uncalled-for lateral incisions, the principal branch of the posterior palatine artery is frequently divided and the palate is, therefore, deprived of its chief source of nutrition.

6. The lateral incisions cut off the nerve supply and muscular atrophy frequently follows.

7. Following the incision, a mass of cicatricial tissue will be formed and a thick, clumsy palate be left instead of one which is flexible and resilient. Besides, with cicatrization there will be contraction and, consequently, defective speech.

8. The operator who makes lateral incisions, usually draws the soft palate forward and upward in order to close the cleft, and by so doing the palate is made so short that correct phonation is impossible. Subsequently the shortening is increased by the contraction which takes place in the cicatricial tissue. It is essential, therefore, to utilize all of the tissues available to form a palate of sufficient length to enable the patient to articulate distinctly. Too frequently we find that the distal border of the soft palate does not reach the posterior wall of the pharynx for reasons heretofore described. While the surgeon who makes lateral incisions may close the cleft, he will find the short, thick, scarred palate will not bring to the patient the benefits anticipated. Any operation, therefore, which includes the making of lateral incisions of the soft palate and completely dividing the tensor palati muscle will be followed by defective speech and hearing (Fig. 440). The division of this muscle is *worse than useless. It is unnecessary and positively detrimental to the best interests of the patient.*

By reason of the cleft of the soft palate, the muscles do not develop as perfectly as they would if the tissues were united and brought into normal action. Like other muscles, they need exercise to bring them up to a high state of development.

It should be, therefore, the aim of the surgeon not only to close the cleft of the palate, but to avoid incisions with their resulting cicatrices; to preserve the continuity of the mucous membrane; and to lengthen the palate, if possible, so it will reach the post pharyngeal wall. The separating tuberosities carry with them the hemispheres of the soft palate which when united is tense, nonresilient and too short to reach the distal wall of the pharynx followed by defective function. The making of lateral incisions posterior to the tensor palati muscles has been advocated and practised. These, too, are unnecessary. The only lateral incisions required are those through the membranes covering the hard palate for the purpose of closing holes and in lifting the palato-pharyngeal muscles in the operation of lengthening the palate.

REMOVING SUTURES

Following operations on the soft palate, the lead plates, silver and horsehair sutures should remain in place ten days, when they should be removed. Patients old enough to be controlled will hold the mouth open and assist

the operator in removing the sutures. Patients who resist the operator may, in some cases, require an anesthetic. The oral speculum introduced enables the operator to remove the sutures with little difficulty since it depresses the tongue and gives him a perfect view of the parts. The removal of the lead plates should be very carefully done, as they may drop backward into the pharynx, fall into the trachea or be swallowed. In older patients with the speculum in position, whether the patient be anesthetized or not, the twist of the wire is seized by delicate forceps, drawn downward a little and, with suitably formed scissors, the anterior wire is cut close to the plate. Then the wire on the opposite side is seized by the forceps, drawn downward, and the posterior wire is cut close to the plate. The plates, remaining still in position, are held by the wires which pass through the tissues. The operator will have an abundance of time to enable him to seize the plate on one side and lift it away, after which he seizes the opposite plate and lifts it away pulling the long ends of wire with it. Prior to adopting this plan of removing the plates, I regarded the taking of them from the mouth as one of the most hazardous procedures attending the surgical treatment of the soft palate.

In patients under six months, for whom the bones have been placed in contact, the removal of the sutures is usually accomplished without an anesthetic and with the greatest ease. They should be permitted to remain for six weeks, as we must regard the treatment, when the bones are moved together, in the same light as we would the treatment of a fracture and allow the bony union to take place before the splints, so to speak, are removed. It is preferable to cut the wires beneath one lead plate, which can be done easily by slightly lifting it. The plate is then removed. No little hooks should be left on the ends of the cut wires, where they were bent. The opposite plate is then seized by hemostatic forceps and lifted away with the wires which extend through the bones to the plate just removed.

LENGTHENING THE PALATE BY UTILIZING THE PALATO-PHARYNGEAL MUSCLES

Following an operation upon the palate, especially one in which lateral incisions have been made, though the palate unites it is usually shortened, and, while improvement in speech is made, the defect is not entirely overcome. To meet the requirements in such a case the palate should be lengthened.

In previous pages I have pointed out that in cleft palate patients who have not been properly operated upon in early infancy, the bones spread, the muscles are not normally developed and when united the palate will be defective in function due to being too short. The pharyngeal muscles, by reason of the greater activity and use to which they are subjected,

become broader and thicker than in a normal palate. They are seen as broad, flattened bands extending from the palate downward and outward to be inserted in the posterior part of the thyroid cartilage (Figs. 443 and

FIG. 442.

FIG. 443.

FIG. 442.—Showing normal palate in complete relaxation. (*Makuen.*)

FIG. 443.—Showing contracted soft palate after operation with a large opening impossible of closure leading from the oral to the nasal cavity. (*Makuen.*)

By utilizing the pharyngeal muscles shown in Fig. 445 the palate can be made as long as desired. (*Brophy.*)

FIG. 444.—Same as Fig. 443 with levator muscles in contraction, the oral cavity entirely cut off from the nasal cavity, and the palato-pharyngei muscles in position to perform their cord stretching function. (*Makuen.*)

444). By utilizing *two-thirds of each palato-pharyngeal muscle* and adding the tissue to the end of the palate, we are able to secure as long a palate as we wish (Fig. 445). The distance posteriorly and the difficulty of secur-

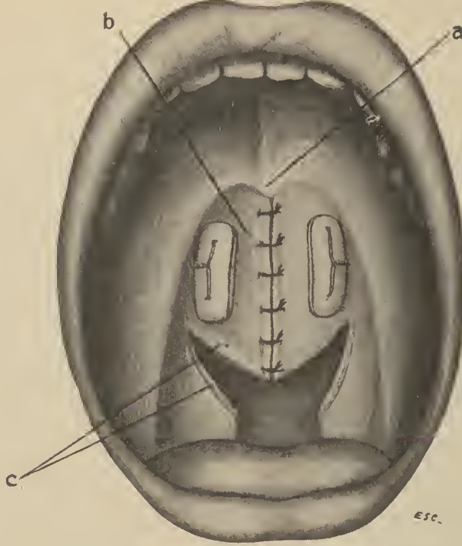


FIG. 445.—This figure illustrates the manner of lengthening the palate by utilizing the palato-pharyngeal muscles. This is after Makuen's Fig. 443. *a*, End of uvula muscle. *b*, Right palato-pharyngeal muscle. *c*, Incision made through two-thirds the width of the muscle. The lead plates are shown with the silver wires twisted so as to approximate the edges of the wound.

FIG. 446.—Manner of lengthening palate by utilizing portion of pharyngeal muscles. Showing posterior view with wires in place.

ing a good view of the muscles of the pharynx make the operation an extremely difficult and tedious one. The muscles should be picked up and the edges freshened as low down as we desire to make use of them. Having the muscles freshened on each side, we introduce two wire tension sutures (Fig. 446), to which we fix lead plates. Before placing the lead plates in the mouth in contact with the tissues, we introduce one silk suture through the lower end of the freshened surface of the muscles. The object of using silk in this place is that we need greater strength than horse-hair will afford, to hold these parts together while placing the other sutures, which should be of horse-hair. With the horse-hair sutures adjusted, they

FIG. 447.

FIG. 448.

FIG. 447.—Plaster cast of short soft palate before operation.
FIG. 448.—The palate has been lengthened one inch.

are held by the use of hemostatic forceps, until all are tied, after which the plates are carried into place. The freshened edges of the muscles move into contact easily. The plates are then carefully adjusted to the parts. This should be so done that even pressure is made upon the soft parts throughout the entire length of the plates.

The next step is to seize the muscle and divide it from below upward a little below the plates (Fig. 446). The function of the muscles of the pharynx is not impaired while the palate is lengthened sufficiently to enable it to come in contact with the posterior pharyngeal wall. By the use of the silver tension sutures and lead plates, the parts are held in contact, thus

securing a union of the freshened edges. The success attending this operation, not only in securing union of the parts, but in bringing great relief and satisfaction to the patient, has been most gratifying (Figs. 447 and 448).

The palate is made long enough by this operation to close the post-pharyngeal opening. It can be made flexible and resilient by proper massage. This will enable the patient to speak distinctly. The muscles of the pharynx will develop to the desired extent. The power of muscular tissue to develop is well shown in Fig. 173. If half as much effort were bestowed on the exercising of the muscles of the palate after operation as the athlete devotes to the enlargement of the muscles of the arm, most gratifying results would be more often obtained.

MORTALITY OF CLEFT PALATE OPERATIONS

From the Chicago Department of Health I secured the following figures for this city. There were 56,543 births reported during the year 1921. There were 5051 deaths in children under one year.

Deaths occurring in infants under 1 year............	5051
Deaths occurring in infants 1 to 4 years inclusive....	2296
	7347

It is justifiable to figure the death rate of infants according to the number born. From the above, the death rate in infants from all causes in 1921 is 12.99 per cent. The results of my last cases show a very marked decrease in the mortality. I believe this is due to more exacting requirements as to the general condition of the infant before operation and to improved technic. By comparison we find Chicago's death rate in infants under one year is almost three times the death rate following my operation in the same year. The mortality rate in New York City and other large cities does not differ materially from the city of Chicago.

In computing the death rate I have not endeavored to separate the patients who died from other causes than the cleft palate operation. I have recorded all who died while under my care. I usually have these patients under observation for at least two months. Some of them have died when they have been under observation for three months. The greater number have succumbed to gastro-enteritis. The operation has apparently not had anything to do with the death. It is possible that the operation may have been a contributing factor in some. I have, however, included them all. The mortality has been extremely low. It is a well known fact that cleft-palate infants after they reach a couple of months of age are usually underfed and a very poor surgical risk. The child

CLEFT PALATE OPERATIONS

Age	Operations to 1915 Number	Operations to 1915 Deaths	Operations from 1915 to 1921, inclusive Number	Operations from 1915 to 1921, inclusive Deaths
1 month	238	48	154	7
2 months	285	51	134	3
3 months	180	10	99	5
4 months	148	10	72	3
5 months	81	18	42	0
6 months to 1 year	255	13	108	0
1 year	222	51	187	6
2 years	59	4	215	6
3 years	199	12	125	4
4 years	126	1	120	0
5 years	98	5	76	0
6 years	58	0	61	0
7 years	68	1	51	0
8 years	66	0	31	1
9 years	29	0	30	0
10 years	42	1	108	1
11 to 15 years	228	1	109	1
16 to 20 years	252	0	77	0
21 to 25 years	148	1	76	0
26 to 30 years	148	0	81	0
Over 35 years	55	0	35	0
	3085	227	1991	37

Total operations.......... 5076
Total deaths.......... 264

Percentage Table

	All cases	1915 to 1921 inclusive
Percentage of deaths of all ages	5.20	1.80
Percentage of deaths under 1 year	9.37	2.95
Percentage of deaths from 1 to 2 years	13.93	3.20
Percentage of deaths from 2 to 4 years, inclusive	3.19	2.17
Percentage of deaths from 5 to 10 years, inclusive	1.11	0.55

just born is usually well nourished and has not had its digestive organs disturbed. It is, therefore, a better operative risk than the infant who has had the nurse, mother, doctor and the neighbors try the various proprietary preparations on it. Since I have insisted that the infant should be brought into good physical condition and the proper food given, I have had much better results, as will be seen by reference to the table.

Many authors of eminence, including Lawson Tait, state that the death rate among children with cleft palate who have not been operated upon is from 25 to 50 per cent.

Among the many surgeons who *know my technic* and who have used it successfully for many years, Vilray Papin Blair states: "The immediate mortality of the Brophy operation is very low. We have twice lost three-month children within twelve hours after operation. We have seen a few infants die some weeks or months later after operation; but this has occurred only among cases in which the nutrition of the infant was persistently bad beforehand, and the operation was undertaken in the hope of improving the condition. In these latter cases death could not be attributed directly to the operation, although no doubt it had been a contributing factor. We think it fair to state that we have seen a much larger percentage of deaths among infants that we were trying to get into shape for operation than in the first few post-operative months."[1]

ACQUIRED CLEFT PALATE

Pathological.—Acquired cleft palate may be pathological or traumatic. Syphilis is the most common cause of the pathological form of cleft palate, as it so frequently involves the bones of the nose and hard palate. The soft tissues may also be invaded. Destruction of the palate as a result of disease leaves a hole instead of a cleft; the treatment, however, is the same. The disease manifests itself usually in the nose first, invading the floor of the nares, the membranes being destroyed by a process of ulceration, the bones becoming exposed and, in time, necrotic. The soft parts covering the hard palate ulcerate, the necrotic bone finally exfoliates, leaving a hole, varying in size from a small sinus to an opening as broad as the palate. The management of an abnormality of this character calls for more than surgical interference. The patient should undergo a long course of treatment, the ulcerations should have healed and the tissues be brought back to a condition such as would warrant the surgeon in proceeding with an operation. For medical treatment and care of the patient, see works on syphilis. The methods to be employed in the surgical treatment of the defect do not in any sense differ from those described under the head of secondary operations (Figs. 427 to 436). It is unnecessary to state that an operation attempted for the cure of a defect of the palate from syphilitic ulcers, before the patient has undergone a long and successful course of treatment, would be almost certain to result in the sloughing of the parts, leaving a condition much worse than that which preceded the operation. If, however, the disease has been sufficiently eradicated from the system

[1] Surgery and Diseases of the Mouth and Jaws, page 166.

to allow slight wounds to heal promptly, an operation may be made with reasonable hope of success.

Traumatic.—Traumatic defects of the palate do not occur often in young children, though in my own practice, a child three years of age, in playing with a small china doll, fell upon it, thrusting the doll's arm into her mouth. The palate was perforated, leaving a hole one-fourth of an inch in diameter. When I was called to see it, the hemorrhage was considerable, but this was quickly checked by plugging the cavity and no treatment was required later except to freshen the edges from time to time. At the end of three weeks, the cavity closed by the formation of granulation tissue.

A workman employed in a lumber yard was struck in the mouth by a large hook suspended from a derrick. The hook passed behind the hard palate, was forced upward through it and into the nose, separating the bones leaving an opening three-fourths of an inch in diameter. The fragments of bone were hanging to the soft parts when the patient came into my hands. All of these were returned to their proper positions, the teeth were ligated together, a few stitches put in the soft parts, and in four weeks the defect of the palate was completely removed.

Gunshot wounds and bayonet thrusts furnish examples of palatal injuries calling for surgical treatment. In such cases, the displaced parts should be readjusted as carefully as possible and suturing done when necessary to hold them in position. As in the treatment of all wounds, the parts should be irrigated and made as clean as possible, prior to the adjustment of the fragments, and antiseptic cleanliness should be faithfully carried out under the care of the operator. Injuries of the palate have occurred during operations upon the throat and tonsils, which call for surgical treatment. Sometimes we have palatal defects as sequelæ of measles, scarlet fever and diphtheria, also from the removal of tumors of the mouth and nose. So far as operative surgery can remove the defects, the technic of the surgical methods previously described will meet the requirements in each case. Should plastic surgery fail to overcome the defect, prosthetic methods may then be employed.

CHAPTER III

ATRESIA PALATI[1]

Atresia palati has received little attention on the part of surgical writers. The literature of the subject examined furnishes but few references to this abnormality.

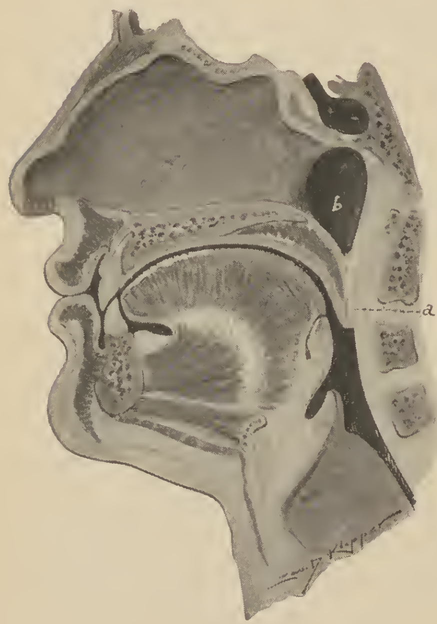


FIG. 449.

FIG. 450.

FIG. 449.—A longitudinal section of the mouth and pharynx. *A* shows adhesions of the palate to the posterior wall of the pharynx. It will be seen that the passage between the nasal cavity and the pharynx is completely occluded. *B* represents the pocket between the palate and posterior wall of the pharynx in which secretions accumulate and cannot escape except through the anterior nares.

FIG. 450.—*A*, the wire oral speculum in position; *B*, the heavy silver probe, bent and introduced into the nostril, carried back to the posterior wall of the pharynx, serving as a guide in separating the palate from its adhesions; *C*, the knife employed to separate the palate from the posterior pharyngeal wall.

Adhesions of the palate to the posterior pharyngeal wall may be the result of trauma or disease. Among the traumatic causes may be mentioned adhesions following the removal of adenoid growths and tonsils and

[1] Published in Jr. National Dental Association, vol. 8, No. 5. May, 1921.

the improper use of escharotics in treating the throat. This condition has also resulted from gunshot wounds. It has occurred in some cases after operations utilizing the pharyngeal muscles in lengthening the palate.

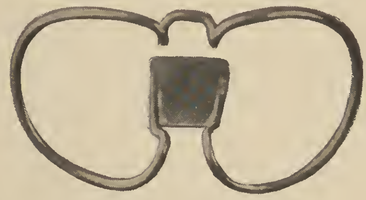


Fig. 451.—Wire oral speculum.

Any force or disease that will produce an abrasion of the membranes of the palate and throat may lead to adhesions. The diseases which affect the mucous membrane of the throat and palate, such as syphilis, diph-

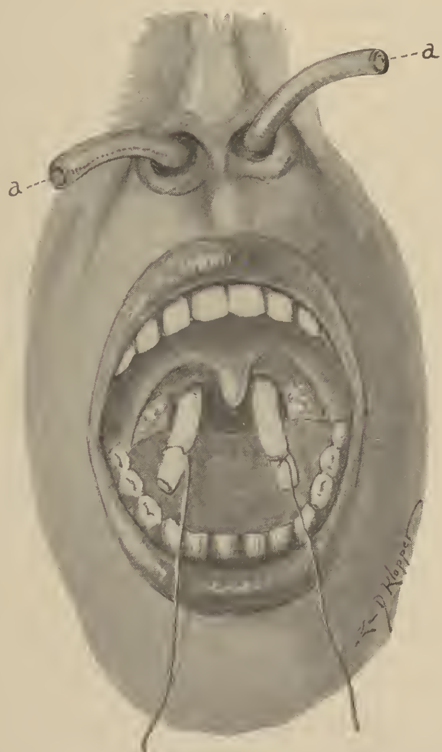


Fig. 452.—*A-A* are the catheters carrying silk sutures into position.

theria, scarlet fever, measles, etc., frequently are attended by extensive inflammation of the mouth, throat, and palate, leaving a fresh, excoriated surface which may lead to the adherence of the palate to the post-pharyn-

geal wall. When the palate is separated from the posterior pharyngeal wall it is certain to reunite unless some substance is introduced to prevent union until the freshened surfaces heal.

Five cases of atresia of the palate have come to me within the last four years. These sufferers found great difficulty in getting relief from their affliction. Many surgeons of great repute have declined to operate, for reasons which it is difficult to understand. Improvement without surgical treatment is impossible.

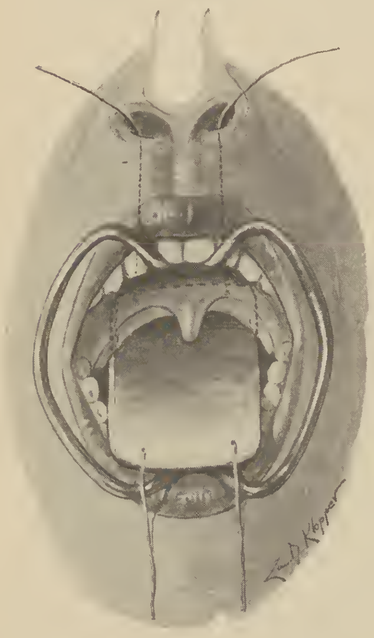


Fig. 453.

Fig. 454.

Fig. 453.—Sutures carrying rubber plate into position between the freshened surfaces.

Fig. 454.—*A-A* are sutures firmly holding rubber plate in position between the freshened surfaces. *B* is a rubber glove finger stuffed with cotton, placed over the columna of the nose to protect it from abrasion by the silk sutures which hold the upper portion of the rubber plate firmly in place.

Recently, a boy of about nine years, suffering from atresia of the palate, was directed to me. This boy's tonsils and adenoids had been removed some months previously. The freshened surfaces united, completely closing the space between the nose and pharynx. Above the point of adhesion a large pocket was formed, in which the nasal secretions accumulated and there remained, only to be drained by the patient when leaning his head forward far enough to permit the fluid to be literally poured out of the nose. A patient thus afflicted cannot blow the secretions from the nose; consequently they remain in the pocket, a source of constant annoyance and ofttimes great distress.

In this case, a physician, feeling that he should do something to establish a passage between the nose and mouth, made a transverse incision across the palate above the point of adhesion. There was a passage through this large opening, but the adherence of the palate to the posterior wall of the pharynx remained. The problem was to so operate as to release the adherent palate from the pharyngeal wall and to close the opening which had been made about halfway between the end of the palate and the posterior border of the horizontal plates of the palate bones.

Figures 450–454 outline the technic of a course which may be followed by any oral surgeon or laryngologist with an assurance that the patient will be cured, barring only those suffering with specific disease. In these cases the tissues may not heal kindly but may, on the contrary, break down by suppurative degeneration. A Wassermann test and all that it reveals should be taken into consideration. If the test is positive, no operation should be made but appropriate medical treatment should be instituted. After the lapse of sufficient time, with a negative Wassermann, although not always reliable, an operation may be made with reasonable expectations of success.

ARTIFICIAL PALATES

The deformity of congenital cleft palate, as I have endeavored to point out in the consideration of the subject, should be treated surgically in early infancy and the parts united before the child has arrived at the speaking age. It is too apparent to require argument that every defect or deformity, congenital or acquired, should be corrected by surgical methods when possible. In neglected cases, while many of them are amenable to surgical treatment, followed by correct speech, we sometimes find the parts in older patients atrophied; or, when many unsuccessful operations have been made only a small amount of cicatricial tissue remains, out of which a good palate cannot be made. A busy and highly successful operator in labio-palatal surgery, stated recently that 85 per cent. of the patients upon whom he operates have been previously operated by other surgeons unsuccessfully. Some of these patients have undergone many operations.[1] Where there is not sufficient tissue to enable the surgeon to produce good palates, artificial palates should be constructed to enable patients to improve defects in articulation.

I have pointed out that an operation, followed by union of the borders of the cleft which has been accomplished by employing lateral incisions, the making of scar tissue and the shortening of the palate, is of little or no value to the patient in assisting him to speak plainly. If the palate cannot be lengthened by utilizing the palato-pharyngeal muscles so as to enable the patient to speak well, an artificial palate should be used.

[1] Delayed operations are usually followed by extensive spreading of the arch. When the tuberosities spread the soft palate, when united, forms a drumhead-like mass of tissue, too short to reach the post-pharyngeal wall.

CHAPTER IV

INFANT FEEDING

By F. W. Belknap, B.S., M.D.

The various means of introducing food into the stomach of a child with cleft palate have been described in another chapter, so that it remains for us to outline rather briefly the general principles which are to guide us in feeding the infant. It is not possible in a restricted space to give either all the data which have accumulated or the more or less scientific basis from which they may have been evolved.

Mother's Milk.—It is an established fact that in by far the greatest number of cases it is easiest and best to rear the infant on mother's milk. When that is not possible (a contingency arising much less frequently than some authors would make us believe), it would be of great advantage to have some human milk at the disposal of the infant, particularly during the first months of its life. Unfortunately, the difficulties of obtaining suitable wet nurses are so great that only a few cases can be supplied. In some cities there exist institutions where bottled breast milk can be obtained, but even where none exist, it is possible, with some effort, to obtain human milk.

Since it is understood that our first object is to give the infant the benefit of the mother's breast, we will occupy ourselves with the technic of nursing. Only too frequently are we told that the mother's milk does not agree with the infant and, therefore, it has to be taken off the breast and started on artificial feeding. While this may be true now and then, in the great majority of cases a little close scrutiny will reveal the fact that the failure was not due to the unsuitable quality of the mother's milk, but to faulty management in the nursing. The most potent stimulus to obtain a sufficient supply of milk is the sucking of the infant.

When to Start Infant Feeding.—An infant is put to the breast first in twelve to twenty-four hours after birth. As a rule, lactation is established on the third or fourth day. In some instances it may not occur before the end of the first or, even, the second week, therefore, the efforts toward establishing a sufficient lactation should not be given up prematurely. When the lactation is delayed, we may have to resort to additional feedings for some time, besides giving water. This feeding should be kept at as

low a level as possible. Usually it is sufficient to give 50 to 60 cc. of cows' milk, diluted in the proportion of one part of milk to two parts of water, either at regular intervals or after each nursing.

Hours of Feeding.—From the start it is well to observe regular nursing intervals, keeping in mind that our régime may have to be changed to suit the individual. It is best to try a four-hour interval, with not more than six feedings in twenty-four hours; for instance, 2, 6, and 10 A.M., 2, 6 and 10 P.M., offering the baby water in addition. It is preferable to alternate breasts with the meals and to give only one breast at a feeding. The advantage of such a régime is that it is much less exacting upon the mother, which is very important since it offers her a chance for rest and recreation. Indeed, under such an arrangement many more mothers would be willing to nurse their babies. Furthermore, it is of equal benefit to the infant, minimizing the dangers of over-feeding. Sometimes it may become necessary to increase the number of feedings, but hardly ever will it be found necessary to give more than eight in twenty-four hours.

Duration of Each Nursing.—The duration of the single meal may be left to the baby, as a rule, particularly if this is done from the beginning, since the baby knows perfectly well when it is satisfied. It loses interest in the nursing, plays with the nipple instead of sucking, and is ready to go to sleep. It is one of the cardinal rules not to induce the baby to further efforts when these signs manifest themselves. The duration of the single meal may vary between five to twenty minutes and very rarely is the latter time exceeded.

Stomach Capacity.—Under a régime as outlined above, it is evident that the single meal will exceed the stomach capacity of the infant. The size of the stomach has been emphasized frequently as of great importance in determining the permissible amount of milk introduced at a meal. While its size may not be disregarded entirely, nevertheless the records of babies of good development should warn us not to lay too great stress on this point. These babies do well on meals exceeding the stomach capacity. The following table illustrates this point:

Age	Stomach capacity		Amount taken at a meal		Number of meals
	Holt	Pfandler	Average	Maximal	
2 weeks	40 cc.	....	90 cc.	138 cc.	6.2
4 weeks	64	90 cc.	110	160	6.0
8 weeks	108	100	140	216	5.8
12 weeks	144	110	146	239	5.7
16 weeks	160	125	154	267	5.5
20 weeks	....	140	172	265	5.3

The figures for the size and number of meals were taken from a number of cases reported in the literature where the amount of milk taken by an infant was determined at each nursing for a protracted period of time and where the babies developed very well.

Another reason which has been advanced in favor of frequent feeding is this, that the stomach of an infant is found empty one and one-half to two hours after a meal. This is an excellent reason for not feeding more frequently, but there is no reason at all for feeding when the stomach is empty. That the stomach capacity need not determine the size of the single meal is

FIG. 455.—Illustrates the use of the Brophy rubber velum for closing the open space in a cleft palate. The mother holds the velum in place by the handle enabling the child to nurse and easily swallow its food. After palate operations the velum should not be used nor should the child be permitted to nurse. It should be fed only with a spoon or medicine dropper until the sutures are removed.

very evident from the fact that part of the milk leaves the stomach while the nursing is in progress. Of the various factors governing the emptying of the stomach we may mention one: the state of filling the small intestine, inasmuch as this factor could easily explain the good results obtained with various régimes. If a baby is fed every two hours, the small intestine will not have time to empty itself as well as when longer intervals are adopted, consequently, less milk will be taken. Regurgitation or other disturbances will be more frequent. On longer intervals, the small intestines have time

to discharge their contents and more milk leaves the stomach during nursing, thus permitting the introduction of a larger amount.

Difficult Feeding Cases.—Where the establishment of the lactation is beset with difficulties and when the presence of a weak or vigorous infant, or one to whom the duration of the nursing cannot be trusted, require deviations from the rules, the necessity of expert advice cannot be dispensed with. While under normal conditions lactation will be sufficient under the above régime, in cleft palate cases the baby sometimes cannot

Fig. 456.—A simple breast pump which is easily made. (*Am. Jour. Dis. of Children.*)

be put to the breast satisfactorily in spite of the various devices employed. Here the milk has to be withdrawn and we lose the most potent stimulus for either establishing lactation or keeping it up. In order to establish and keep up lactation, it is best to put a normal infant to the breast. Where this is not possible, we have to resort to the breast pump. With the best of these, the mother applies the suction intermittently by means of a tube connected with the glass nipple (Fig. 456). In all cases where the breasts have to be emptied artificially, skillful management is essential. Milking the breast by hand is frequently more successful than

pumping. The areola is taken between the thumb and first finger, the breast drawn gently forward and downward with slight pressure, then released and the motion repeated. While the different methods will not be successful at all times, in many instances the supply of milk is sufficient for the demands of the baby.

Management of Breasts.—Whatever method is employed, great care must be taken to prevent breast lesions. The apparatus should be boiled in water for twenty minutes and the breast itself should be washed with sterile gauze and water to which a little alcohol may be added. This should be done before and after milking. It is well at all times to wear a piece of sterile gauze over the nipple and adjacent parts. When the breast is manipulated, the hand should be washed with soap and water and finally rinsed with sterile water. Should any excoriation of nipple or adjacent parts occur, it may be touched with a six to ten per cent. silver nitrate solution and then washed with sterile one per cent. sodium chloride solution. An ointment much used is one containing silver nitrate one per cent., balsam of Peru ten per cent. and vaseline eighty-nine per cent. Others recommend a solution containing three per cent. tannic acid, twenty per cent. glycerin and seventy-seven per cent. alcohol. When associated with much pain, dusting with orthoform has proven valuable.

In order to be able to detect and correct errors in the technic of nursing, one has to pay attention to several factors. The most common mistake is overfeeding, particularly when a baby is fed according to some rigid plan as outlined in many books without paying heed to its individual demands. For instance, a feeding is given every two hours and the baby kept on the breast for fifteen to twenty minutes. At first the baby gains weight very rapidly, sleeps well and the bowels are in good condition. Then the weight becomes stationary or there is even some loss. The baby cries much, is fretful, maybe vomits more or less frequently, while the stools increase in number, their color and consistency change and more or less mucus appears. Often it is claimed then that the breast milk does not agree with the baby and it is changed to artificial feeding. This is a serious mistake as all that is necessary is to put the baby on a restricted diet. Here, again, it becomes necessary to keep in mind the baby as well as the source of the milk supply. As far as the baby is concerned, the interval between feedings is lengthened and the time of feeding shortened. For instance, instead of feeding every two hours the intervals are changed to four hours, with a nursing time of three to ten minutes, according to circumstances. It must be remembered that the baby receives more milk in the first few minutes than later on. During the first five minutes it may receive as much, or more, as in the following ten minutes. Furthermore, with the normal breast the composition of the milk undergoes a

change during nursing, the most important being the gradual and constant increase in fat. However, this is not always the case. Where the milk supply is very abundant, the fat content rises at first, becoming stationary for some time, to rise again at the end. In other instances, after reaching a certain point it finally drops. With regard to the mother, it is very important that not too great a residue of milk is left in the breast. The breast readily adapts itself to the demands thrown upon it. Frequent nursing, particularly when the baby is made to empty the breast thoroughly, leads to an abundant supply of milk, whether this be of benefit to the nursling or not. If the nursings are reduced in frequency, too much milk may be left in the breast. Under such conditions the milk is likely to revert to a colostral character and finally stop entirely. It is very important, therefore, to guard against milk stasis by removing the excess of milk from the breast, either by the breast-pump or by manipulation. As a rule, pumping will not be necessary for more than a few days or a week, when the breast will adapt itself to the new demands. How important the prevention of milk stasis is may best be seen by the experience gained in institutions which supply wet nurses. It was found that a woman having nursed two or three babies successfully was returned after a week or two because her milk had given out. The reason for this occurrence is obvious. Even when the production of milk has ceased, it may be re-established by persistent effort at nursing after the lapse of a month or more.

Controlling Mother's Milk by Diet.—Here we may discuss briefly the hygiene of the nursing woman, particularly with regard to diet and exercise. As a rule, it is best to make no great change in the mode of life to which the nursing woman has been accustomed. It is of no benefit to change the diet of a woman accustomed to rather coarse fare to one of a more refined and rich nature. This result may be an indigestion, with consequent disturbance of the lactation. Neither is it well to confine too closely to the home a woman accustomed to exercise or work. Sometimes, where the milk has been found too scanty in amount, a careful increase in the amount of food should be given, preferably in the form of milk. It has been claimed that the administration of such highly nutritious preparations as maltropon is of beneficial influence. If the milk supply is too abundant, the food, particularly rich proteins, may be restricted and some exercise given in the open air. Where the fat content of the milk is too low, food rich in proteins is advised, although the fat content of the milk can be raised from a low level to a higher one, up to a certain point, by the administration of such food as cream and bacon. If the milk contains too much fat on a diet rich in proteins and fats, it may frequently be reduced to a proper level by excluding those articles given for the purpose of aiding the lactation and introducing a larger amount of water.

Collecting and Testing Mother's Milk.—The points just raised entail a chemical analysis of the breast milk. The normal composition is as follows:

Proteins	1-1.5 per cent.
Fat	4.0 per cent.
Sugar	6-7 per cent.

The method of obtaining the milk for analysis is just as important as the analysis itself. It is but a waste of time to examine a single sample of milk obtained at random. An ideal method of obtaining the milk for analysis would be to withdraw a twenty-four hour amount of the milk, analyze a specimen of this, and feed as much of the rest as is desirable, but this is rarely applicable in practice. With the baby at the breast, the following procedure is the most satisfactory: Before and after each nursing in the twenty-four hours, an equal amount of milk is taken, all the samples are mixed, and this examined. Each time only a little milk need be taken since a total of about 30 cc. is amply sufficient for all the necessary tests. For determining the milk fat, 5 cc. is sufficient.

Drugs Passing into Milk.—A few words may be added with regard to a number of drugs passing in the milk, such as salicylic acid, antipyrin, etc. Some pass particularly when given in fatty vehicles as the iodin preparations. On the whole, the amount of drugs entering the milk is not very great and they may be given in moderate doses with safety. Alcohol passes rather readily and alcoholic beverages had better not be taken by a nursing woman. It is of interest, in this connection, that certain immune bodies pass into the milk. Morphin interferes with the production of milk.

Contra-indication to Nursing.—Of the contra-indications to nursing, we may mention any disorder likely to endanger the life of the infant, as drunkenness or convulsive attacks, like epilepsy. Tuberculosis of the mother is also regarded as one of the absolute contra-indications. On the other hand, certain infectious diseases, like pneumonia, influenza, even uncomplicated typhoid fever, diphtheria, etc., do not constitute a contra-indication to nursing, but they require a careful handling of the baby so as not to expose it to the infection (washing of hands and breast, covering the infant with a cloth, etc.). Neither does a mastitis not broken through into the milk-duct necessitate the removal of the baby from the breast. Indeed, under such conditions, a continuance of nursing is advisable in order to keep up the flow of milk. At the same time, the normal breast-fed infant is known to possess a rather great resistance to infections. The return of menstruation can be neglected. Renewed pregnancy will, as a rule, prompt the transition to artificial feeding sooner or later, although

there are instances where the new baby simply replaced the older one on the breast.

Wet Nurses.—Naturally, all the points discussed thus far pertain alike to a mother and a wet nurse. In employing a wet nurse it is well, as a rule, to select a woman between twenty and thirty-five years of age, who has shown her efficiency as a milk producer for about six weeeks. The period of lactation is of no consequence. The best means to judge the ability of a wet nurse is her own baby, which should be permitted to nurse also, particularly where her charge is rather feeble. The wet nurse should be free from venereal diseases and not be employed without previously making a Wassermann test. Neither is it permissible to expose a healthy wet nurse to a syphilitic child. In the latter case, and when there are obstructions to nursing as in cleft palate, the milk may be withdrawn and fed from a bottle. Under such circumstances it is usually desirable that the wet nurse's own baby be put to the breast. It hardly needs to be mentioned that the wet nurse should be free from tuberculosis or other manifest diseases. Her position, from a social point of view, need not be discussed here.

Determining the Food Tolerance.—To return to the baby. Von Pirquet presented the fundamental facts concerning successful feeding in a clear and simple manner. We take for granted that the composition of the human milk is a proper one. During the first months of life, with the exception of about the first week, we may accept one hundred grams of milk per kilogram of body weight as the amount of milk necessary to sustain the weight. On this amount, the baby does not gain weight, but it does hold its own. If we drop below this, it will lose weight. If we exceed, we achieve a gain in weight. Increasing the food, we see that this gain becomes greater in proportion to the amount of food given. On a further increase, however, the gain may continue, but not in proportion to the amount of food given in excess, and, finally, by still further increasing the food, the gain in weight stops or gives way to a drop if we persist in feeding these latter amounts. The amount of food yielding the relatively best increase in weight is the optimal diet; the amount of food which, on further increase, leads to a stand-still of the body weight, is the maximal diet. We see then that our feeding will be successful anywhere between the sustaining and the maximal diet. This determines the tolerance of the baby, the upper limit of which is formed by the maximal diet. Substituting average figures for these different diets, we may then go on the assumption that 100 cc. breast milk, or 70 calories of a well-balanced food constitute the sustaining diet; that about 150 cc. breast milk, or 105 calories, constitute the optimal diet, while 200 cc. breast milk, or 150 calories per kilogram, mark the maximal diet. (The number of calories per kg. are desig-

nated as the quotient of energy.) In the example just given, it is seen that the latitude of tolerance is such that feeding the infant between ten per cent. and twenty-two per cent. of its body-weight may yield results. If we want to test whether the amount of food a baby receives approaches the maximal diet, we add, say, 100 cc. to the diet for a day. If the weight of the infant shows a corresponding increase, the previous diet has not been the maximal one permissible. While the tolerance of a given case may vary widely, we are less likely to err with regard to the sustaining diet in the average normal case. For therapeutic purposes this is the most important feature, for whenever the limit of tolerance is exceeded for any length of time, the value for maximal and optimal diets are depressed. For instance, suppose the maximal diet just mentioned has been exceeded, it will be found, on continuing this diet, that we get a drop in weight and we have to reduce the diet to 150 gm. per kg. in order to obtain a gain. This means that the diet, which formerly constituted the optimal diet, is now the maximal diet, while the optimal diet now lies between the sustaining diet and the new maximal diet. In such cases, *i.e.*, where the nutrition has suffered, it is the custom to drop immediately to the sustaining diet and gradually increase the food under control of weight, clinical behavior and stools. This scheme not only serves with advantage in breast-fed infants, but also in those raised artificially. It must be kept in mind that the limit of tolerance may be depressed not only by mismanagement of feeding, but by means of diseases as, for instance, measles, etc. Excessive feeding not only makes itself felt in the weight curve, but also in the number and character of the stools, in the clinical behavior, oscillations of temperature, fretfulness, loss of sleep, vomiting, etc.

Determining Amount of Milk a Baby Receives.—The question now arises as to how we are to determine the amount of milk a breast-fed baby receives. This is easy enough when withdrawn human milk is given. When the baby is on the breast, it must be weighed before and after each feeding in the twenty-four hours, preferably for more than one day. It is absurd to weigh the baby only before and after one nursing, since the amount of the single meal is subject to entirely too great variations. Weighing the baby before and after each nursing will at once solve the question of over- or under-feeding; a question which, in little pronounced cases, is not so easy as it may appear on first sight. An infant not receiving sufficient nourishment will cry after feeding, but so will one in distress from too much food. In both cases offering more food will, for a while, at least, inhibit this crying. In both the weight may remain stationary or decrease. The children become fretful and lose sleep. The stools may become more numerous, loose, green and slimy in both cases. When the inanition becomes more pronounced, the character of the stools may

assume a brownish color and change to peat-like consistency. The characteristic hunger stool is dark and of the same consistency. The similarity of the symptoms where over-feeding has been in progress for some time, with depression of the limit of tolerance, and where an insufficient amount of food is given may easily be understood. In the former, the infant cannot make use of the food and, from this point of view, it is in the same condition as the one which does not get sufficient food. The over-fed infant is even worse off, because the excess of food serves now as an injurious agent. It is for this very reason that we have to guard the infant so carefully against prolonged excessive feeding. Some infants, it is true, relieve themselves promptly of an excess supply of food by regurgitation, but this is by no means always the case and cannot be relied upon.

Normal Weight Increase.—The judgment of the success of the feeding presupposes a knowledge of the development of the normal infant which reaches its birth weight at about the tenth day. The following figures, it must be understood, are average figures based on a birth-weight of 3000 to 3500 gms. It must be remembered that an individual infant need not fall within this scope. In an individual case we may judge whether the gain in weight is satisfactory in various ways, using as a basis the birth-weight. The infant should double its birth-weight early in the fifth month and should treble it at the end of the first year. Taking these figures into consideration, an infant weighing 3000 gms. should weigh 6000 in the fifth month. This would mean a gain of 600 g. per month during the first half year and of about 500 g. the second half year. This is not exactly correct for the progress of weight is not uniform, the maximal period of growth coinciding about with the third or fourth week of life. The average gain for the first five months is as follows:

Months	1st	2nd	3rd	4th	5th
Per diem	29	27	24	16	15
Per month	868	872	716	489	460

Other Factors in Normal Infants.—At the period of the maximal growth, more of the breast-milk is utilized for building up the body than before or after. It must be kept in mind that in weighing the baby, the weight has to be taken at the same time of day. An ideal weight curve should show an uninterrupted gain while a stop in the gain of weight cannot be considered strictly normal. The gain in weight is not the only criterion for the development of the baby. It is necessary to pay attention to its general condition. The skin should be elastic, firm, smooth and of a rosy hue. The muscles should show a good tonicity. The temperature of the infant on constant outside temperature should not oscillate much more than 98.2–99° F. (36.8–37.2° C.). When awake it should be cheerful, show a tendency to

move its limbs actively and pay attention to its surroundings, being easily detracted. The first few days the sleep should be almost continuous, quiet and rather deep, only interrupted by meals. During the first weeks of life, the infant sleeps about twenty hours, or more, of the twenty-four. During the first half year, it will sleep sixteen hours, or more, staying awake from one-half to two hours. With one year the total sleep will amount to about fourteen hours. The normal infant does not need any inducement to go to sleep, like rocking, etc., particularly when not unduly excited and the diaper is kept dry. The number of stools in twenty-four hours should be from one to three. They should be homogeneous, of ointment-like consistency, yellow in color and acid in reaction. Microscopically, detritus, a few fat globules, fatty acid crystals and bacteria are seen, most of the latter being gram positive and growing in an acid media. The most prevalent form is bacillus bifidus communis, Tissier. The gram negative forms, like bacillus colon communis (Escherich) are numerically less. The amount of urine excreted in twenty-four hours after about the first week is approximately sixty-eight per cent. of the fluid ingested. It is of low specific gravity, about 1003, and acid in reaction. It may be of interest to note a few peculiarities of the urine of the normal breast-fed infant. According to Moll, the twenty-four hour urine of a normal, breast-fed baby does not contain more than 10 to 20 mg. P_2O_5. Taking 10 cc. samples for examination, the amount of P_2O_5 is so small that he designates such urine as free from phosphates.[1] Furthermore, it has been shown that the urine of the normal, breast-fed infant is free from glycuronic acid, nitrates and nitrites. The test for these substances, when present, may indicate, first of all, very slight disturbances, but they may be of special value in judging whether a disorder of the nutrition in the breast-fed infant has completely cleared up. Of special interest is the fact that an insufficient amount of food does not lead to marked increase of the phosphates in the urine. This may serve to distinguish readily such cases of slight inanition which were mentioned above.

Artificial Feeding.—The study of artificial feeding of the infant is still empirical to a great extent. It is beset by many difficulties, due to the fact that, under normal conditions, the infant like the adult possesses a wide tolerance with regard to the amount and composition of its food. Thus a diet may be borne for some time without giving rise to any visible ill-effect, but, if continued, it may prove unsuitable and harmful. Naturally, the latitude of tolerance is of great benefit to the infant. Thus we understand readily why so widely different mixtures can be fed successfully. When called upon to regulate the diet of a given infant, it is not possible to test the latitude of its tolerance, so we must decide upon some method, which

[1] For this test, see standard text-book on Urinalysis.

experience has taught promises results in a majority of cases. Another desirable feature of any method of feeding is simplicity.

The good results obtained on the breast have been used as the starting point for artificial feeding. Soon it became evident that cow's milk, by far the most important substitute for human milk, differed in its composition from the latter. This is not the place to enter into a detailed discussion of these differences. Neither can we allot any space to a discussion of the variations of the cow's milk derived from different breeds, nor to the variations in the composition of the milk of a single animal. It suffices to point out that milk, serving as food for an infant, should be mixed milk from a large number of animals, excluding breeds whose milk is known to contain a special high fat content. It is preferable to obtain the milk from Holstein Friesian cows.

Fig. 457.—Improper method of holding the nursing bottle. The bones of a young infant are easily molded so the nipple pushes the hard palate upward and presses the alveolar processes forward. This causes the maxillæ to protrude, thus producing a marked deformity in certain cases. The alveolar processes of the mandible are also pushed backward. Sucking of the thumb and the use of the pacifier will cause the same deformity in many instances. (*Brophy.*)

The herd should be under the supervision of a competent veterinarian and tuberculin tested. The production and shipping should be under competent control, thus insuring the necessary cleanliness in obtaining and handling the milk. It should be cooled immediately, shipped and delivered cool. The proper handling after its delivery is as important. The milk should be kept on ice and thoroughly protected until it is prepared for use. When the desired milk mixture is prepared, it is put into nursing bottles, which are placed in a vessel containing cool water. The water is brought to boiling and kept there for about five

minutes, whereupon the bottles are cooled as rapidly as possible and put on ice until used.

Composition of Milk.—The main differences between human and cow's milk are these:

	Protein, per cent.	Fat, per cent.	Sugar, per cent.	Ash, per cent.	Total solids, per cent.
Human milk	1.5	4	6–7	0.2	12
Cow's milk	3.5–4	3.5–4	4.5	0.75	12

The proteins of cow's and human milk show a further difference. Human milk contains about as much, or more, protein other than caseinogen, while in cow's milk the caseinogen exceeds these proteins considerably.

FIG. 458.—Proper method of holding the nursing bottle. (*Brophy.*)

The fat of human milk contains less volatile fatty acids and more unsaturated fatty acids. With these differences it was but natural that efforts were made to modify cow's milk to resemble human milk in order to obtain good results. Here we may point out a very striking fact. In nearly all methods of modifying cow's milk, the first mixtures given contain a relatively low percentage of protein, approaching the protein content of human milk. With advancing age of the infant, the proteins are increased. In this we have a striking contradiction to the breast-milk whose protein content during lactation changes very little and in the opposite direction. This fact seems to demonstrate very clearly that the nature of the two kinds of food, as known thus far, is not such that the one need serve as an absolute guide in the preparation of the other.

Formulæ.—The beginning of the artificial feeding is the most difficult part. During the first week the infant, as a rule, receives relatively little

food. The milk is diluted with two equal parts of water or barley water, to which solution may be added some carbohydrate. In the following table a rough sketch of the feeding is given:

Age	No. and amount of single meals	Total amount	Proportions	Carbohydrate
1 wk.	6×20—60 cc.	120–360 cc.	1 milk 2 barley water	2–10 grams
2–4 wks.	5×100—150	500–750	1 milk 2 barley water	20
5 wks.–2 mos.	5×150—170	750–850	1 milk 1 barley water	30–40
3 mos.	5×180	900	1 milk 1 barley water	30–40
4–6 mos.	5×180—200	900–1000	2 milk 1 flour	30–40
7–9 mos.	5×200	1000	2 milk 1 flour	40–50

We have confined ourselves to giving a very rough table, and even this is done with a certain degree of reluctance. First of all, it is always hazardous to raise an infant on a table where only the age is taken into consideration. Then there are many infants thriving well on the same milk mixture for a prolonged period, and a change should only be made when indicated by the needs of the infant. As Czerny and Keller state, those acquainted with the signs of over- or under-feeding do not need any tables, while those not acquainted with these signs do not derive much good from them. A very simple way to determine approximately the daily total amount of food for a baby is this: During the first quarter, the baby takes about $\frac{1}{5}$ to $\frac{1}{6}$ of its body weight; during the second about $\frac{1}{7}$, and later on about $\frac{1}{8}$ to $\frac{1}{9}$. It is started on a mixture containing one part of milk to two parts of barley water, reaching whole milk about the eighth or the ninth month. The changes are thus made according to the demands.

Carbohydrate Content.—Carbohydrate is added according to its deficiency in the milk used. For instance, an 800 cc. mixture is given of half milk and half barley water. Four hundred cc. milk contain 18 gm. carbohydrate. The total amount should contain 56 gm., so we have to add about 38 gm. Besides, it has been found that many babies thrive better when, in addition to the sugar, some flour is added to the milk. This may be given in the form of wheat, barley or oatmeal flour. During the first month 5 gm. of flour are added to each liter of milk mixture; in the second 10 to 20 gm., in the third 15 to 30 gm., and in the second quarter 30 to 40 gm. The flour is stirred with luke-warm water and boiled ten to twenty minutes. As long as the infant is well, milk sugar can be used for

the carbohydrate addition. If any disturbances arise, it is better to add dextri-maltose or cane sugar. If we wish to calculate the amount of food on the basis of the energy requirement, we remember that the normal breast-fed infant needs about 100 calories per kg. body weight during the first quarter year; 90 in the second; 80 in the third; and 70 in the fourth. One gram of protein yields about 4 calories; 1 gm. of carbohydrate 4 calories; and 1 gm. of fat about 9 calories. The artificially fed infant may require a food somewhat higher in caloric value.

Fortunately, the latitude of tolerance, as pointed out above, permits of rather wide variations in the amount and composition of the food. Nevertheless, in artificially fed cases it is well to watch for signs of excess with even greater care than in the breast-fed baby, and we cannot emphasize too strongly the necessity of expert advice as soon as the infants do not do well; in fact, all artificially fed infants should be under constant, competent supervision. Furthermore, it is a very good rule to begin with a relatively scanty diet, increasing it with careful observation of the results.

Here we have to limit ourselves to a very brief discussion of a few points concerning the composition of the food. For some of the methods which are in vogue, particularly in this country, we refer the reader to the current text-books on Pediatrics. We refrain intentionally from outlining the methods in which simple milk dilutions are enriched by the addition of fat in the form of cream, since, according to Finkelstein, the addition of the carbohydrates insures success in a larger number of cases.

Alkalis.—Many authors recommend the addition of alkali because, in human milk, the relation of alkali to acid is greater than in cow's milk. Commonly, lime water is added, which, when freshly prepared, corresponds to a $\frac{1}{20}$ alkali solution. During the first few months, five per cent. is added, *i.e.*, 5 cc. to each 100 cc. Others recommend the addition of sodium bicarbonate. Another factor is the inhibiting influence of alkalis on the rennet reaction, which tends to prevent the formation of large, tough curds in the stomach. This can be accomplished more readily by decalcifying agents or, rather, agents rendering the calcium of the milk unavailable for the rennet reaction. Sodium citrate (two per cent.) is used for this purpose most frequently. It seems that the infant is thus capable of assimilating more concentrated milk mixtures, particularly in early life. There are some theoretical reasons why the addition of alkali to the milk may be of benefit, classifying sodium citrate among the alkalis. The ash of human, as well as cow's milk, is alkaline. The ash of one gram of milk corresponds to the alkalinity of about 0.15 cc. one-tenth normal sodium hydroxide solution (Kastle). The alkalinity of the ash is called the available alkalinity of the milk because, assuming that the infant burns its food as in ashing, a certain amount of alkali is available for the

economy of the organism. Sodium citrate contains sodium in such amounts that 1 gm. of the salt yields enough sodium to make about 84.5 cc. one-tenth normal sodium hydroxide solution. Should the citric acid of the molecule be burned in the organism (and, indeed, the urine may readily become alkaline), we see that a considerable amount of sodium remains at its disposal. The addition of 0.2 per cent. sodium citrate to whole milk would a little more than double the available alkalinity of this milk, and it is not improbable that it is due to this increased available alkalinity that the infant may take care of greater milk concentrations. It may be mentioned that orange juice yields an alkaline ash, while the ash of oatmeal is acid.

Stools.—The result of the feeding is judged by the same token as in the breast-fed infant. With regard to the stools there is this exception: the stools are alkaline in reaction, with a preponderance of gram negative bacteria, belonging to the colon group. The reaction and the bacteria may be influenced by the diet. For instance, on feeding a mixture relatively poor in protein and fat, but rich in carbohydrates, the stools become acid and the gram positive micro-organisms prevail, as in the breast-fed infant. The possibility of influencing the stools and general condition by the diet, in lighter cases of nutritional disturbance, is of great therapeutic value. Green, loose, foul-smelling passages may be corrected by reducing the protein and adding carbohydrates. Here it becomes necessary to call attention to a very significant fact. When we change the amount of one of the ingredients, we not only change it, but we alter the relationship of this ingredient to the others. Suppose we have a mixture containing two per cent. protein, two per cent. fat and six per cent. carbohydrate, and change to one per cent. protein. The previous relationship of 1 : 1 : 3 is changed to 1:2:6, that is, the balance of the food ration is altered considerably. *This balance is of great importance.* Another very important feature is the relationship of the mineral constituents of the food to each other and to the other ingredients of the food. In practice we have been accustomed to speak of an increase or decrease in protein, fat or carbohydrate, but we should not lose sight of the other radical changes we introduce. To return to the influence of the diet on the stools. If the stools are loose, acid and perhaps, foamy, they may be corrected by increasing the proteid and reducing the carbohydrates.

Nutritional Disorders.—When meeting with difficulties in raising the infant on artificial feeding, the management of its nutrition should be entrusted to a physician well acquainted with the various disorders of nutrition. We will give a brief outline of the most satisfactory classification of the disorders of nutrition at our disposal, the one given by Finkelstein. The disorders of the nutrition are characterized by the fact that manifesta-

tions of disease are due to the abnormal course of the processes of nutrition and that no other factors, as, for instance, infection from the outside, enter into consideration. The food, therefore, is the one injurious agent. Finkelstein classifies the disorders of nutrition thus:

1. State of disturbed balance.
2. State of dyspepsia.
3. State of decomposition.
4. State of intoxication.

In all cases of disorders of nutrition, a careful history is very important.

1. *State of Disturbed Balance.*—Here, in spite of a diet suitable in its composition and sufficient in caloric value, the gain in weight does not proceed normally. The weight curve shows ups and downs, while *in toto* some gain may be registered or the weight may remain stationary for a long time. Other signs of disturbed health are not wanting. A previously healthy infant may enter the state of disturbed balance, a state where its reaction to food is abnormal, for various reasons. An unsuitable diet or infection may lead to it. It must be understood that the infection only changes the reactivity of the infant to food. A change of the reactivity is overcome by choosing a food which can be assimilated easily. In another group of cases, the diet has been one suitable for normal babies and there is no history of any previous injury, so we have to consider them as of low tolerance congenitally.

A diet may be unsuitable either by introducing too large amounts of otherwise suitable milk mixtures or giving mixtures, which are deficient in one or more ingredients, for too long a time. This may happen easily when some therapeutic food is used. The most frequent and best known disorder entering into consideration here is the injury of the nutrition due to milk, the so-called "Milchnähr schaden" (Czerny and Keller). On a diet apparently well tolerated, the baby's weight becomes stationary, the sleep disturbed, while during waking hours the baby is restless. The mucous membranes and skin become pale. The tonicity of the muscles is reduced and the abdomen is distended. The stools are dry and white, the so-called "soap stool." Besides, there may be itching eczemas and the urine may acquire an ammoniacal odor. If the diet is changed now, there may be a prompt improvement. It has been found that the fat of the food has to be diminished and the carbohydrates increased when the disorder has lasted for some time. In very mild cases, skimmed milk, in different dilutions, may be all that is necessary. Later on, quicker results are obtained by means of Keller's malt-soup. In other cases, buttermilk, with addition of sugar, has been used with success. Under treatment, the stools become softer while the general clinical picture shows a decided

improvement and the weight curve begins to move upward. Human milk has proved of great benefit in this condition, even though it has a high fat content. The younger the infant, the more advisable it is to give human milk. On human milk, the bowels may first become worse (*i.e.*, loose, green, slimy and more frequent for a few days) and the weight drop. After about four days a marked improvement begins, which, later on, can be accelerated by substituting one meal of human milk by one of a mixture poor in fat and rich in ash, like buttermilk. It cannot be emphasized too strongly that the food mixtures used here for therapeutic purposes should not be continued for too long a time. In the disorders of nutrition there occurs a period of reparation, that is, the time during which the infant is in need of a therapeutic food, but it cannot be regarded as cured until it can tolerate a milk mixture suitable for its age and weight. When this time has arrived, the continuance of the therapeutic food may lead to renewed disturbances. Under certain conditions, the baby may do well on condensed milk after having had trouble on other milk mixtures, particularly such rich in fat, but if the condensed milk is continued too long, it may lose weight again, get diarrhea, etc. This period of reparation does not only occur in the state of disturbed balance, but in other groups as well.

2. *State of Dyspepsia.*—This group is characterized by an acute disturbance of the gastro-intestinal tract with more or less diarrhea. The weight may drop somewhat or remain stationary, and the temperature rarely exceeds subfebrile values. The most important therapeutic procedure is the reduction of the food to the sustaining diet. A more detailed presentation of this very comprehensive group would lead us entirely too far.

3. *State of Decomposition.*—This represents a very severe disorder of the nutrition, in which the introduction of otherwise suitable food leads to a severe alteration of the general condition associated with a pronounced drop in weight. In severe cases even food much below the sustaining diet may lead to severe reactions and collapse. Decomposition is a sequence of the dyspeptic state where the proper therapeutic measures have not been taken or have been of no avail. An infant in the pronounced state of decomposition is very much emaciated and the skin shows a peculiar pale, grayish color. The sensorium is normal. There is a state of abnormal excitation, the infant always being restless and sleeping little. The respiration shows some deviation from the normal. The pulse is small and slow. There is a tendency to subnormal temperature, which is one of the early and significant symptoms of decomposition. It is remarkable that the appetite is rarely diminished; on the contrary, it may be increased considerably. Frequently both fists are put in the mouth and sucked. The stools are rarely of normal appearance as long as the food of a usual proper caloric value is given. Their character depends on the character

of the food. On reduced feeding, the stools may appear normal and need not be increased in number. Often there is vomiting. To this group of decomposition belong the cases formerly called atrophy where the atrophic state is not due to foreign causes, as, for instance, tuberculosis.

The so-called "Eiweiss milch" of Finkelstein and Meyer is frequently used in the treatment of this condition. It is prepared as follows: One liter of milk is coagulated by means of rennet and the whey is allowed to drain off. The coagulum is taken up in half a liter of water and passed through a fine sieve under gentle pressure. It is then added to one-half liter of buttermilk. The mixture is bolied after the addition of about 10 gm. of flour. In the beginning, about 20 gms. of dextri-maltose are added, later more. At first about 200 cc. are given in twenty-four hours, either without discontinuing the food or after a water diet of about twelve hours. When the stools have improved, the amount is quickly increased to 150 or 200 cc. per kg. of body weight.

4. *State of Intoxication.*—This is characterized by severe diarrhea, a sudden marked drop in weight and other symptoms showing a profound alteration of all the functions of the body. Here we have the collapse and nervous symptoms. The face is mask-like, without the play of the facial muscles for minutes at a time. The eyes remain fixed, the sensorium is affected, the movements of the extremities are slow and they remain in the same position for a long time. There may be chewing motions and other more or less stereotype movements. The temperature is increased and may reach hyperpyretic values. The respirations are slow and deep. The diarrhea may be extremely severe. The pulse is increased and, often, very small. The heart sounds are dull. The number of leucocytes is increased. The urine contains albumin, casts and sugar, the excretion of the latter being purely alimentary. Severe vomiting may occur. The nervous symptoms are usually very pronounced, with strabismus, turning up of the eye-balls and convulsions.

Intoxication may develop either from a state of dyspepsia or of decomposition. In the latter, the prognosis is worse. In spite of its severity, the intoxication may yield rapidly to a proper treatment, which consists of a water diet from twenty-four to forty-eight hours. On resuming the feeding, it is better to start with small amounts of human milk (first flow from breast), giving at first 50 cc. in twenty-four hours. Artificial food is also given in very small amounts at the start.

It must be distinctly understood that we have restricted ourselves to the merest sketch of the question under discussion. It has been our aim to point out the right direction, rather than to furnish an array of formulas and tables which can never replace the study and experience necessary to those who want to give the infant a chance for life.

AUTHOR'S SUPPLEMENTAL SUGGESTIONS

Aids in Feeding Cleft Palate Children

A child born with a cleft palate is usually as well developed at birth as a normal one. Too frequently, however, the congenital defect is overlooked by the attending physician, who fails to observe the child's struggle in deglutition, food regurgitation, etc. He is informed the child cannot nurse and sees that for want of food it frets and cries and loses weight from day to day. The child is suffering the pangs of starvation. It is imperative that the physician should make a careful physical examination of every newborn child in search for congenital deformities. He may discover a defective palate or his attention may be called to it. He then directs the use of the breast pump, as the child cannot draw the milk from the breast since the misplaced, separated bones of the open palate make suction impossible. The milk drawn by the pump may be fed by a drop tube or a spoon, but the difficulty in swallowing taxes and irritates the child and retards its development.

The mother, who may have a super-abundance of good, nutritious milk, finds the flow diminishing and realizes that the child's natural food will soon be gone. The flow of milk from a breast that is pumped will, as a rule, soon terminate, while the warm, vital lips and tongue of an infant will stimulate the flow. When the mother's milk is gone, artificial food must be used. Cleft palate children brought for operations are often—due to their difficulty in swallowing and the result of improper feeding—suffering from gastro-enteritis, malnutrition, etc., and are so emaciated that even the care of the expert pediatrician is not always successful in upbuilding them and fitting them for operation.

A healthy mother's milk is the ideal infant food, but a cleft palate baby cannot draw it, nor can he swallow except with difficulty. Sir Lawson Tait has stated that the mortality of children who have cleft palate is so great by reason of their failure to secure proper nutrition that an early operation is desirable.

I have devised two instruments by the use of which a cleft palate child can draw its food from the mother's breast or from a bottle with little difficulty at his first trial, and after he learns to use them, with as much ease and comfort as he might if his palate were normal.

One instrument is a soft rubber velum held in place with an aluminum handle (Fig. 459). The mother places this velum in the child's mouth and holds it there by the use of the handle. Then the child is put to the breast (page 266, Fig. 455). The velum completely closes the cleft of the palate while the child is nursing. The little circle on the under side of the handle of the velum fits over the nipple and this enables the child to

draw the milk easily. The illustration shows how the mother assists the child to use it when he takes the breast. It is surprising and intensely amusing to see how quickly the infant recognizes how helpful this instrument is to him. He soon learns (though it may sometimes take patience and persistence to teach him) that with it he can draw and swallow his

FIG. 459.—Author's rubber velum used when the child nurses the breast. The mother places the velum in the child's mouth against the palate, holds it by the handle and nurses the child. This prevents the milk from regurgitating through the nose and enables the child to swallow without difficulty. If the flange is too large to fit in the child's mouth it may be easily made smaller by trimming with scissors. If it extends too far back, it is apparent that it will disturb him and prevent swallowing. The hole in the nipple may be enlarged if necessary by the use of a hot needle.

FIG. 460.—Author's cleft palate nipple. The flange is so constructed that the cleft is covered. This enables the infant to nurse without the milk getting into the nares.

food. He knows that without it he cannot draw his food nor swallow it with ease. Therefore, he noses around for the instrument before trying to take the breast.

The second instrument has also a velum attached to a nipple to be used on the bottle (Fig. 460). The nipple, with velum attached, is placed in the mouth and, the velum completely closing the fissure, the child is enabled to draw its food quite as easily as though the palate were

normal. This instrument has been used with success for several years and has been thoroughly tried out. It has been termed by a distinguished member of the profession, "The Cleft Palate Infant Life Preserver." The velum may require cutting so as to make it fit the child's mouth and the hole in the nipple may need to be enlarged. The hole may be easily enlarged by using a hot needle and the velum reduced in size by the use of scissors.

These instruments must be used faithfully and persistently until the child becomes accustomed to them.

I have introduced two figures to illustrate the correct and incorrect positions of the bottle when the child is taking its food.

Correct Method.—Fig. 458 illustrates the correct way of holding the bottle. It is held in such a manner that no undue pressure is made upon either the upper or lower jaw. Whatever force may be applied by the bottle when held as shown, is equally distributed above and below. The soft, incompletely ossified bones cannot, then, be displaced by the use of the feeding bottle.

Incorrect Method.—It will be observed in Fig. 457 that the bottle is held down upon the infant's chest, causing leverage forward upon the anterior part of the upper jaw and backward at the same time upon the lower jaw. This is sufficient in a young infant, whose bones are about one-half organic matter, to force the anterior part of the upper jaw forward and the lower jaw backward. Holding the bottle improperly in feeding is responsible for innumerable cases of facial asymmetry leading up to actual deformity. The alveolar processes of the upper jaw are in this manner forced forward and the alveolar processes of the lower jaw are forced backward. When the teeth are erupted, the upper incisors will often protrude and the lower incisors will occlude far posterior to the upper ones, creating a deformity that might be termed a parrot-face. The same kind of deformity is produced by the habit of thumb-sucking. All parents should be warned against the improper use of bottles and the unfortunate habit which children form of sucking the thumb.

A child cannot nurse following an operation upon either lip or palate until the tissues have healed. A few days before the operation is performed, the nursing of the mother or the use of the bottle should be discontinued and the child fed by a spoon or drop tube, so that he may learn to take his food in that way without fretting or being disturbed. This manner of feeding is to be continued until two weeks after the tissues heal, when he may be returned to the breast or the bottle. The time that the child is away from the mother will not be long enough to cause the loss of her milk, if proper care is exercised. Therefore, he continues nursing the mother until he is well developed and prepared for the third step in establishing a normal palate.

MEDICAL CARE IN CLEFT LIP AND PALATE PATIENTS

By Charles Schott, S. B., M. D.

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This phase of the subject cannot be considered without prefacing the remarks with a few words on the preparation before operation is undertaken. If the infant, for most of this work is done on the very young infant, is to be in proper condition, it must be on a logical feeding, for most of these babies are unfortunately unable to take the breast and often there is no milk for them after a few days when the breast is pumped. The babe usually must be fed with a pipette or spoon, or it may be taught to take the Brophy nipple.

The feeding must be logical—whole milk, mixtures, Albumen milk or some other feeding not condensed milk. The babe must show a steady gain and the stools must be of the proper character. These babes should be given very careful attention by one who understands the infant. Then, too, certain types of babies are usually better risks than are others. The slender infant is a far better risk than is the fat one.

For at least ten days before the operations are scheduled, 3 per cent. Soda Bicarbonate solution should be given in as great amounts as possible, or should be given for as long a time as is necessary to completely alkalinize the patient. This is to be determined by its urinary reaction. The reason for this is obvious, in that a considerable degree of acidosis follows every operation, due to the anesthetic and starvation. The infant should be given no enema before it goes to the table; should have feeding to within four hours of the time of operation, and soda bicarbonate solution to within two hours of operation.

The consideration of the post-operative procedure must be taken up in three distinct and separate stages, conforming to the three operations usually performed, namely, the arch of the bones, the lip and the soft palate.

For the arch of the bones operation, which is the least severe from the shock point of view, it is necessary only to make sure that the infant is properly alkalinized. If not, then before it leaves the operating table hypodermoclysis of Ringer's Solution containing glucose in a 6 per cent. proportion should be given under the breast, not less than 100 cc. to 150 cc. This is readily done and the absorption is rapid. As soon as the child awakens, glucose 6 per cent. and soda bicarbonate 3 per cent solution should be given by mouth in as large amount as possible and as frequently as possible. No hesitancy need be employed, fearing too much may be given. Too much cannot be given.

The first feeding is given eight hours after operation. The babe usually will not take all of its feeding, but if two or three ounces are taken that will suffice with the amount of glucose solution and whisky or brandy in five drop doses every two or four hours. If the patient is very restless, morphine may be used, but that is not necessary after this operation.

The lip operation usually follows the bone operation in from six to eight weeks. In this time one may see that the infant is brought into an ideal condition. This is extremely essential for this, in my opinion, is the most severe of all the operations as to shock and collapse. Sodium citrate is given throughout the interval, in dosage of twenty grains daily and then for the ten days immediately preceding the operation, soda bicarbonate in the 3 per cent. solution is given.

After the operation no gastric lavage should be attempted in that it is not necessary now that the suction apparatus is used during the entire time that the operation is in progress. Glucose 6 per cent. solution is given by hypodermoclysis on the operating table and two or three times during the first twenty-four hours. During the day glucose 6 per cent. and soda bicarbonate 3 per cent. solution are given by mouth in as great amounts as possible and again the feeding is begun eight hours after operation. It is essential that the infant be kept as quiet as possible following this operation, and morphine should be given to bring about this quiet for four days to a week if necessary. Crying should be prevented, thus insuring a better result.

The soft palate operation, which comes usually in sixteen to twenty two months after the first two operations, is handled in a somewhat different manner. Here it is even more important that absolute quiet is obtained for several days. If it is possible, nothing should be given by mouth for three or four days after operation. The child should have only glucose, 6 per cent., by hypodermoclysis and proctoclysis. It is important that the repaired palate be given as much freedom from mechanical effort as possible. At best, it is acting as a diaphragm with each respiratory effort and if the swallowing act is permitted along with this other movement, a good result will be difficult. Therefore, nothing by mouth other than just the moistening of the lips. Morphine is used ad lib. in this phase of the procedure.

Following all the operations, it has been found that if stimulation is needed, Digalen or Digifolin is the best drug of choice, with brandy or whiskey.

For the interval between the lip and palate operation—the fifteen odd months—if the child is kept under proper supervision, it is much to its benefit. Not permitting it to become a fat, flabby baby is essential.

Proctoclysis is not a satisfactory therapeutic measure in infancy.

Even the drop method is not well retained. When it becomes necessary to use a rectal therapeusis, retention enemas of four to six ounces given every four hours may be used with fairly good results in the older children undergoing the palate work. These same methods should be carried out in the palate work upon older children up to ten or twelve years of age.

These methods of procedure are the ones that have been used with considerable success for some time past. It must be borne in mind that proper preparation is the chief essential. If the infant is properly prepared, much of the after grief and much of the heroic methods need not be encountered or necessary. However, if the after treatment in these cases is followed as given in this article, the results will be better as to result of operation per se and for condition of the child.

CHAPTER V

THE TRAINING OF SPEECH AFTER CLEFT PALATE OPERATIONS

By G. Hudson-Makuen

Importance of Palate.—There is a popular notion that the tongue is the chief organ of speech and that the sense of taste is located in the palate. When a person is talkative, he is said to have a "long tongue;" when he is caustic in his remarks, a "sharp tongue;" and the Biblical reference to the "unruly member" is well understood. Moreover, it is not an uncommon thing to hear it said that certain articles of food and drink "tickle the palate." Physiologically it would be more accurate to refer to the palate as being the "unruly member" and to regard the tongue as the organ in which is located the sense of taste.

Both the palate and the tongue are important organs of speech, but the former is the more so, for not only is it essential in the enunciation of nearly all the elements of speech, but, owing to its direct attachment to the larynx, it is also an important factor in the production of voice. The vowel sounds may be articulated when the palate is defective, but their resonance is so much impaired that they are scarcely recognizable and their pitch cannot be changed with any degree of accuracy. It is in the articulation of consonant sounds, however, that the palate is especially essential.

The Consonants.—Of the twenty-three consonant sounds, only two, the "m" and the "n" can be given intelligibly when the palate is not intact, and even in these the resonance is somewhat impaired. All those consonant sounds in the enunciation of which the tongue is a conspicuous factor, the th, hard and soft, s, z, sh, zh, t, d, n, l, r, k, g, ng, h, y, as well as those in which the lips and teeth are used, the p, b, m, wh, w, f and v, are impossible to a person with a defective palate. This is true because, in the enunciation of these sounds, the palate is necessary to confine the breath to the oral channel and to prevent it from passing up through the nasal chambers.

How Made.—It will be borne in mind that the consonant sounds are made by impeding the moving column of breath at certain points above the larynx. The points at which the impediment takes place have been called the stop positions. These have been divided into the anterior, the middle and the posterior stop positions. The anterior one is formed by

the lips (in the articulation of the so-called labial sounds, p, b, m, wh, w), by the lower lip and the teeth (in the articulation of the labio-dentals, f, v), and by the tip of the tongue and the teeth (in the articulation of the linguo-dentals, th′, th″); the middle one by the tongue and the hard palate (in the articulation of the anterior linguo-palatals, s, z, sh, zh, t, d, n, l, r); and the posterior one by the dorsum of the tongue and the soft palate (in the articulation of the posterior linguo-palatals, k, g, ng, h, y). For all these sounds requiring an impediment in the outgoing column of breath, whichever stop position may be used, it is necessary to have a freely movable and normal palate.

PHYSIOLOGICAL TABLE OF SOUNDS

Vowel Sounds

E.	A.	Ah.	Aw.	O.	OO.

Consonant Sounds

	Voiceless oral.	Voiced oral.	Voiced nasal.
Labials	P.	B.	M.
	Wh.	W.	
Labiodentals	F.	V.	
Linguodentals	Th′	Th″	
Anterior Linguopalatals	S.	Z.	
	Sh.	Zh.	
	T.	D.	N.
		L.	
		R.	
Posterior Linguopalatals	K.	G.	Ng.
	H.	Y.	

Function of the Palate.—The function of the palate in the articulation of consonant sounds, therefore, is two-fold. In all those sounds in which it does not assist in the formation of the stop position, it serves as an obturator between the nose and the pharynx, completing the partition between these two cavities and compelling the outgoing breath to pass through the particular stop position required for the sound. For instance, in the articulation of labials, labio-dentals and linguo-dentals, the sounding breath must pass through the anterior stop position, and the palate serves to diverge it in this direction and to prevent it from passing through the nostrils. In a similar manner, when the hard palate is intact and the middle stop position is used, as in the articulation of the linguo-palatals, the sounding breath must pass through this constricted aperture, and the function of the palate is to prevent it from passing upward through the nostrils. In the use of the posterior stop position, which is formed by the

junction of the velum palati and the dorsum of the tongue, the soft palate serves a double purpose. Its free border rises against the posterior pharyngeal wall, closing the avenue to the nostrils, and its anterior surface, acting in conjunction with the tongue, forms the stop position for the sound. In the enunciation of these posterior linguo-palatal sounds, a perforation of the hard palate would have little if any, effect upon the articulation, but it would somewhat modify the vocal resonance.

Interference of Speech Due to Palate.—It will be observed that the tongue and the palate act together in the processes of articulation and that the palate also serves to prevent the sounding breath from passing through the nostrils and to focus it upon the particular stop position that is being used. The various defects of the palate that interfere with speech are:

1st. Paralysis of the muscles.

2nd. Perforations.

3rd. A lack of union between the lateral halves, commonly known as a "cleft palate."

The paralysis of the muscles of the palate may follow diphtheria or some other infectious disease, or it may be the result of external violence and, inasmuch as it interferes with the valvular action of the palate and allows the breath to pass up through the nose, its effect upon speech is somewhat similar to that of a cleft palate.

A perforation of the palate effects speech more or less, according to its size and location. If it is in the hard palate, anterior to the stop position which is being used, its effect may be scarcely noticeable, but if it be posterior to the stop position, whether in the hard or the soft palate, its effect is very marked, and if the perforation is a large one, its effect is similar to a cleft in the palate or a paralysis of the levator palati muscles.

Characteristic Speech of Cleft Palate.—The characteristic speech of one having a cleft palate is familiar to all, but its physiology may not be so well understood. The impaired resonance of the voice, caused by a cleft in the palate, is more marked than we should expect, and it illustrates how important is every part of these mechanisms to the normal voice. In addition to this impaired resonance, the cleft palate interferes with the inflections of the voice and thus destroys its natural melody. Moreover, the mechanism or physiology of speech is entirely changed. The formation and practical use of the three stop positions above mentioned are impossible in cases in which the palate is cleft. The anterior and middle stop positions may be formed by means of the lips, the teeth, the tongue and the hard palate (unless this be cleft throughout its entire length), but they never are formed because it is impossible for the patient to focus the

vocalized breath at these points when there is a free channel for it to pass up through the cleft and out through the nostrils. The posterior stop position cannot be formed because, as I have explained above, its formation depends upon a freely movable and normal palate.

The purely vocal sounds, therefore, are the only ones that can be even approximated when the palate is cleft and they, as I have shown, are defective in respect to resonance and melody. The consonant sounds are generally almost entirely unintelligible and they are made with a totally different mechanism. For the three normal stop positions, the patient endeavors to substitute others further back in the pharynx. For some sounds the base of the tongue and the posterior wall of the pharynx approximate to form the stop position, and for others the lips of the larynx formed by the arytenoid cartilages, the arytenoid and aryepiglottic folds are used. With such substitutes for the normal stop positions, situated as they are far back in the throat, it is not surprising that the articulation and phonation should be so defective and indistinct.

Explanation of Defective Speech.—It will be observed that the three defects of the palate, which I have mentioned, have a similar effect upon the character of speech. There is this difference, however. Paralysis of the muscles of the palate and perforations are usually acquired defects and generally appear after the development of the faculty of speech, while the cleft palate is congenital and comes before the development of the faculty of speech. In the former two conditions, normal speech has merely been interrupted, while in the case of a neglected cleft palate, no normal speech has been developed. This explains in part why the speech of a person with a cleft palate is more defective and less intelligible than the speech of those having paralysis of the muscles or perforations. The indications for treatment in the latter two conditions are, in the one, to restore the normal action of the muscles involved, and in the other, to close the perforation either by means of natural tissue or some mechanical appliance. When this is accomplished, the speech generally approximates the normal condition or that condition which obtained before the defect appeared.

Speech Habits.—In the case of the cleft palate, however, where only abnormal speech preceded the defect, we have a very different condition of affairs. It will be remembered that the acquirement of speech habits begins early in the second year and continues during the period of childhood. It is during this time that Nature provides for the normal development of speech. Children appear to inherit a tendency toward speech development and cases have been reported in which whole sentences have been uttered spontaneously without any preliminary practice. The more serious forms of defects of speech are those that are acquired during this

formative period. It is then that faulty impressions of the elements of speech are stored in the auditory centers of the brain and faulty habits formed to the use of the various mechanisms of speech.

When to Correct Defects.—Other things being equal, therefore, all anatomical or structural irregularities having a tendency to impede the normal development of speech during this period should have our most careful attention, and *measures for the correction of these conditions should be adopted as early as possible, before the cerebral impressions and peripheral habits are established.* Inasmuch as surgical measures for the closure of the cleft palate are undertaken largely for the purpose of improving speech, *they should be employed as early as possible before the formative speech period.* Surgical measures, as a rule, however, give the patient only a little better chance for the development of good speech. Even if we were able to furnish the patient with a perfectly normal palate, it is a well-known fact that the character of the speech would remain almost unchanged, because, as I have explained above, the patient has never learned to use the natural mechanisms of speech, but he has been forced to substitute mechanisms that are inadequate to the requirements.

No habits are more difficult to change than habits of speech. The fact is they cannot be changed without special aid and instruction. This is true, mainly, because the ear of the speaker, having grown accustomed to faulty articulation, does not discriminate between it and the normal articulation and considerable practice is required to train the ear to make this discrimination and appreciate good speech while the organs are being trained to produce it.

To make a normal palate take the place of a cleft palate, the soft parts should be so manipulated as to avoid the formation of scar tissue. If this is done, a palate soft and flexible may be produced. If incisions are made through the soft parts and measures omitted to lengthen the palate, masses of cicatricial tissue will form with contractions.

The two reasons for attempting to close a cleft palate are, first, to improve the physical condition of the patient by giving to him a more nearly normal respiratory tract, and, second, in older patients, to improve both his physical and mental condition by giving to him an approximately normal means for communication with his fellows through the channels of oral expression. The second reason for the operation is even more important than the first because the patient's curious and faulty speech affects him both mentally and physically.

Inadequacy of Merely Closing Cleft.—As I have said, the mere closure of a cleft palate in an adolescent or adult person, does not, as a rule, improve the speech to any appreciable extent. I am aware that there are those who hold an opposite opinion, but in the cases that have been

improved, I think some outside assistance has always been rendered. Even the little help that may be given by an intelligent parent is fraught with good results in many instances, but the degree of success that may be obtained is generally proportionate to the skill of the teacher and the ability of the patient for persistent and concentrated effort. It has been said that a faulty habit of speech must be supplanted by a correct one, but it is more than a habit. It is a deeply rooted neuromuscular disturbance or perversion that has arisen from an effort on the part of Nature to accommodate itself to developmental structural irregularities in certain important parts of these mechanisms. It is somewhat analogous to the effort on the part of the neuromuscular mechanisms of the heart to accommodate themselves to a faulty valve, but it is far more complicated because of the volitional and other physical faculties employed in the development of speech.

Movements of the Soft Palate.—As I have shown, the palate is one of the most important organs of voice and speech. Its integrity is essential to the tones of the voice as well as to the moulding of voice into speech by the processes of so-called articulation. The soft palate has a wide range of movement. Its function in vocalization is to assist in controlling the action of the vocal cords and regulating the size and shape of certain important resonance chambers, and its function in articulation is to shut off the nasal from the oral cavity during the emission of the explosive and fricative sounds, and to form contacts with the tongue in the formation of the so-called posterior linguo-palatal sounds. This will be better understood if we glance for a moment at the accompanying charts.

The table (page 290) contains the physiological alphabet of vowel and consonant sounds. It will be observed that the consonants are arranged in groups and named according to the particular organs of articulation employed in their formation.

In Fig. 461 we have a series of drawings of the palate, alveolar arch and teeth, and the shaded portions represent the points of contact of the tongue during the emission of the sounds represented by the letters or symbols accompanying them. I may say that these drawings, taken in part from Kingsley's palatograms, are fairly accurate and the last one is a diagrammatic picture of a complete cleft of the palate.

If we compare the normal palate with the cleft palate and glance at the points of tongue contacts in the drawings, we shall readily see exactly what consonant sounds must be faulty when the palate is cleft and these, of course, are the sounds which we hope to improve by our operation. In addition to these, however, there are other sounds that are defective when the palate is cleft, and they are the explosives and fricatives, which require a complete shutting off of the nasal from the oral cavity. This is well shown by the

drawings of some vertical sections of the organs of articulation in Fig. 462 which drawings, of course, are merely diagrammatic. I would call attention especially to the position of the soft palate shutting off the nasopharynx during the emission of the explosives and fricatives. By a comparison of the physiological alphabet with these drawings, it will be seen that

FIG. 461.—The shaded portions representing the points of contact of the tongue during the emission of the sounds indicated by the accompanying letters. (*N. Y. Med. Jour., July 27, 1907.*)

when the palate is cleft, all the consonant sounds, with two exceptions, will be defective necessarily and, when the cleft extends through the alveolar arch and lip, all will be defective with no exception whatever.

Organ Perversions.—In the absence of the normal palate after the first year, therefore, the patient tries to substitute, for purposes of speech, certain other organs lower down in the throat, such as the epiglottis, the

aryepiglottic folds and the ventricular bands, and in this process of substitution, faulty musculatures are developed, including a faulty development of the nerve centers supplying them. This gives rise to the neuro-

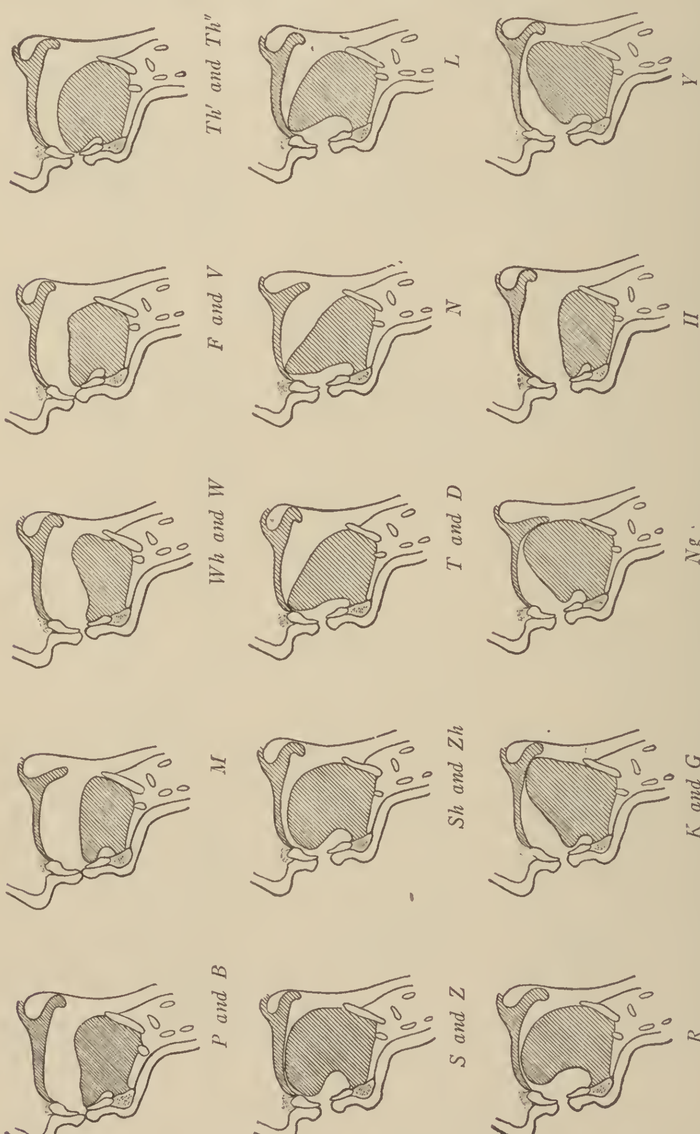

FIG. 462.—Physiological alphabet. Showing the positions of the soft palate and tongue in the articulation of the sounds indicated by the accompanying letters. (*N. Y. Med. Jour.*)

muscular perversion to which reference has been made and which, as I have said, is really more than a habit.

It must be remembered that we are dealing here with a psychical as well as a physical perversion with a faulty development of the central as well

as the peripheral mechanisms of speech, including the receptive, the executive and even the intellectual centers.

The correction of these conditions is by no means a simple procedure. The patient himself cannot accomplish it, because his central mechanisms are involved, and he cannot make a diagnosis of his own case. So accustomed has he grown to his speech that his ear has come to approve it and he cannot discriminate between his faulty forms of speech and the correct ones. He has no ear for correct speech, just as some people have no ear for musical tones and have to learn them by a long and plodding process. Moreover, every day of faulty speech tends to increase these unfortunate psychophysical conditions and to lead the patient farther and farther away from normal speech. The fewer the days of faulty speech, therefore, the better it is for the patient, and hence the importance of doing the operation, if possible, even before the developmental speech period, or within the first year.

Training Needed.—In the adolescent or adult cleft palate patient, training will do more for the improvement of speech than will the operation. In other words, a patient who can have the advantage of but one of the two procedures can probably be given better speech by training alone than by an operation alone. The reason for this is apparent when we consider the limitations of the operation. In the first place, the speech, as I have shown, is defective in three important particulars, namely, in resonance, in melody and in articulation. The extent to which we can improve the resonance and melody of the voice by the mere closure of the cleft is very slight because, however well the operation may be done, the patient will have but limited control of a more or less tense velum and he will be unable, therefore, to regulate the size of the opening between the oropharynx and the nasopharynx. It is upon the regulation of the size of this opening, which is constantly changing during speech production, that normal resonance largely depends. When the opening is large, as in the cleft palate case, the nasal resonance predominates, and when it is small, the nasal resonance is diminished. Moreover, the rapid changes in pitch, which result in the so-called melody of the voice, cannot be made with any degree of accuracy, because the function of the palatopharyngeal muscles, which have their lower attachments in the superior cornua of the thyroid cartilage of the larynx, is, at least, partially destroyed by the cicatricial contractions[1] which

[1] Dr. Makuen's opinions are based, no doubt, upon the observations of palates which have been operated on by making lateral incisions through the muscles. As previously stated, these lateral incisions are wholly unnecessary. Palates thus mutilated, followed by the formation of a mass of cicatricial tissue, cannot logically be expected to function.

Cleft palate operations, properly performed, are essential to prepare one to speak correctly, but to produce a perfect palate will not alone insure perfect articulation any more than a piano of the most improved construction will produce perfect music until one learns to use it.

follow the operation and by the atrophy which has taken place from the disuse of these muscles before the operation was performed.

Tongue Contacts.—As to the other particular in which the speech of the cleft palate case is defective, namely, the so-called articulation, our operation is of greater service because, as we have seen, the hard palate and velum are both essential to the normal tongue contacts of certain of the consonant sounds and if the cleft extends through the alveolar arch and lip, nearly all the tongue contacts in the articulation of consonants will be faulty. Not only are the tongue contacts important, but in the production of many of the consonants there is a damming up, so to speak, of the breath in the mouth and a slight explosive effort as the sound is emitted. When this takes place in the normal mouth, the velum rises and shuts off completely the oral from the nasal cavities, and this is one of the things which the velum of a cleft palate cannot do and which it must be made to do before we can get the best results from the standpoint of speech. The velum of the cleft palate, therefore, should be united in such a manner that it will be as large and as loose as possible with its muscles in their normal positions and relations, and then the patient should be given such exercises as will have a tendency to develop in these muscles their normal physiological functions.

Much depends, therefore, upon the way in which the operation is done, but when the muscles of an adolescent or adult patient with a cleft palate have been united in their normal positions and relations, our work has only begun, because these muscles have become atrophied from disuse; they have no so-called tonus and scarcely any power. In other words, they have lost their normal function and, if left to themselves, they would never regain it, and it is this masterful inactivity of the palatal muscles after the operation, that gives to the speech of the cleft palate case its characteristic quality, and it is the restoration of the function of these muscles, more than anything else, which removes this disagreeable quality.

Kind of Training Needed.—From what I have said we must conclude that the training of the speech, after a cleft palate operation, is an exceedingly important feature of the treatment, and that this training consists in an effort, not only to establish functional activity in important muscles of phonation and articulation but also, to do this under somewhat unfavorable conditions. Fortunately, it is not absolutely essential, in the majority of cases, that the peripheral organs of speech be made structurally perfect in order to enable the patient to acquire fairly satisfactory speech. In other words, the integrity of the peripheral organs of speech is only a factor and, indeed, a comparatively slight factor, in the process of speech development, the chief thing being the integrity of the central mechanisms of speech, upon which is based what has been called the speech instinct.

A child with the speech instinct and with a full development of the cerebral mechanisms of speech will be able to overcome many structural imperfections of the peripheral organs, but a gross defect of these peripheral organs, such as a cleft palate, when it exists for a considerable length of time, interferes with the normal development of the cerebral mechanisms and thus destroys, to some extent, the ability of the patient to overcome peripheral imperfections without some special assistance. Our training, therefore, must be such as to affect central as well as peripheral conditions, and it differs not at all in principle from the training that is required for other forms of defective speech. The purpose of the training is to correct faulty actions of certain muscles and to develop normal action in certain other unused muscles.

Exercises.—A good, all-around exercise for the development of the palatal and pharyngeal muscles is a systematic and vigorous gargling three or four times a day with a warm, sterile solution. Another excellent exercise is to have the patient acquire by practice a voluntary control over the muscles of the palate and pharynx. This is done by an effort to elevate and depress the palate at will, under direct vision in a good light and with a mirror. The exercises should be practised regularly and for a long time under the direction of a teacher. Much may be accomplished also by the mechanical stretching of the palate, and for this purpose a sterile finger or some special instrument may be used by the physician. In addition to these general measures for the development of the mechanisms of speech, a thorough course of training is indicated in both phonation and articulation. Correct breathing is of great importance in this work and exercises should be given to improve the voice, which is especially defective in rhythm and melody.

The training in articulation should be such as to meet the requirements of each individual case. Generally speaking, however, the patient should be taught all the sounds of the Physiological Alphabet and he should be taught to give them as nearly accurately as possible. His ear must be trained to recognize the correct sounds of speech and to distinguish between them and the faulty sounds. All this requires close attention on the part of the patient and long-continued practice under the direction of a skilled teacher. The teacher, to be successful in this work, must understand not only the anatomy and physiology of the organs of speech, but also the effect upon these organs of scientific training.

As early as 1887 the late Dr. G. V. Black stated: "There is a peculiar fact in connection with the phenomena of cleft palate. We may cut away the lips, the teeth and the tongue and the patient may talk plainly after all, but if we cut away the soft palate, it seems to be utterly impossible for the patient to speak perfectly. Rigid training is the most important element in the remedy of these cases, and we may educate the patient to speak quite distinctly, but, as I have said, the speech will not be perfect; there will be a nasal twang. The muscles

that close the nostrils may be brought into use by training. The azygos uvula has the power of projection, and in its efforts to close the cleft, the margins of the muscle will even overlap each other sometimes.

"**Reasons for Failure in Palato-plasty.**—These muscles ordinarily are not used in cleft palate and, if left until adult life, there is atrophy of the muscles owing to lack of use. Now, in order to bring them back into position to close the cleft in the atrophied condition, it requires quite a pull, especially in the anterior half of the cleft. The strong tension under which the muscles are placed militates against the success of the operation. For this reason, operation should be performed in infancy before atrophy of the muscles has occurred. Another very strong reason why the patient should be operated on early in life is to gain an apposition of the parts before any association of speech is formed in the brain. As soon as the child is old enough, it will endeavor to speak whether the cleft is present or not, and if the association of speech has not been properly formed, it is very difficult to rectify it in adult life."

In operating on these cases, it is always best to avoid severing the muscles. The usefulness of the muscles should not be impaired.—T. W. B.

CHAPTER VI

PREVALENCE OF CLEFT LIP AND PALATE

In 1920, the War Department issued a report on "Defects Found in Drafted Men" prepared under the direction of the Surgeon General of the U. S. Army, Major General M. W. Ireland. This elaborate report gives

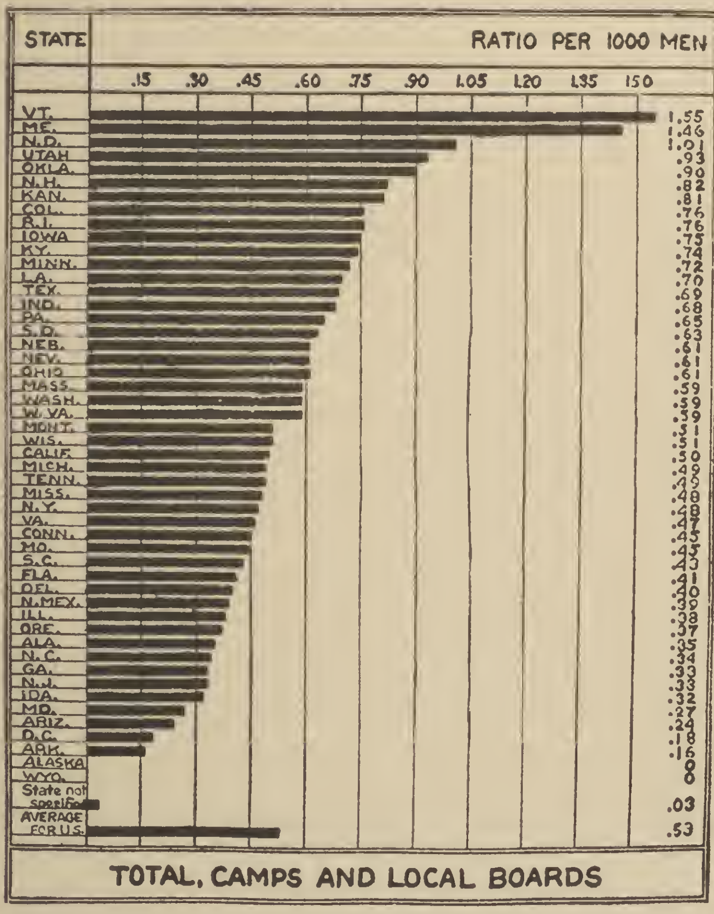

FIG. 463.—Relative frequency of cleft palate in the various states. (From "Defects Found in Drafted Men," War Department, 1920.)

the physical defects found in men registered and examined in pursuance of the selective-service act and contains an enormous amount of information of the greatest practical value.

I quote from it the introduction, and various tabulations regarding the frequency of cleft lip and palate in the different states of the Union. While the statistics given are for a small part of the entire population of the country, the information assists us very materially in estimating the prevalence of these deformities.

INTRODUCTION

This study involves the analysis of the defects and diseases found in about half a million men rejected by the medical examiners of local boards and of two lots of about a million each who were examined at mobilization camps during the physical examinations of the draft in 1917–18. This number constituted about four-fifths of all of the men who were physically examined, and is representative of all. The men examined were of ages 18 to 30 inclusive, but relatively a larger proportion of the male population between the ages of 21 and 30 years is included in these statistics than of those of earlier age.

The importance of a knowledge of the defects in the American population of military age is many sided. It is important from the standpoint of social and industrial life, since it gives some insight into the availability of this population for various occupations which our social organization requires. It has social-medical bearing, since it indicates the physical and medical status of our population in different parts of the country under different sanitary conditions and with varying opportunities of medical and surgical treatment. It has important military bearings, since it indicates the proportion of men available for military service of different kinds. It has a social therapeutic bearing, since it indicates the size and nature of the task before those who would seek to improve by better conditions the physical and mental standing of our population. Finally, it has a biological and eugenic significance in so far as it reveals the inherent failures in man to make complete adaptation to the rapidly advancing requirements of a highly artificial civilization, in so far as it throws light upon the constitutional limitations of the various races to meet the conditions imposed by that civilization, and in so far as it throws light on the influence of military selection on the breeding stock of the next generation.

The opportunity for securing this knowledge was a unique one. The Great War made necessary the mobilization of men of military age under 30 years and it was early recognized that a careful selection was essential of those physically and mentally fit for the severe service that they would be called upon to perform. Consequently, thousands of medical officers were secured for the purpose of such examination. It was done in thousands of local boards and scores of camps for a period of approximately one year. Each man was examined by from 4 to 12 medical officers. These physicians each rendered an independent verdict upon the man's physical or mental condition. In case a significant blemish was found the diagnosis of the defect was recorded upon the physical examination form carried by the recruit. The records thus made were sent to the office of the Surgeon General of the Army, copied upon statistical cards, counted, and tabulated, and they form the basis of the present study.

P. 27, "Defects Found in Drafted Men," War Department, 1920.

Cleft Palate and Harelip.—These associated defects which frequently interfere with speech and cause a blemish of the face, were, in the earliest regulations, regarded as a cause of rejection in so far as they are responsible for fissures or perforations of the hard palate and interfere with mastication and speech. However, in June, 1918, perforations of the hard palate and moderate deformities of the structures of the mouth were ordered conditionally accepted in the remediable group, but irremediable deformities were ground for unconditional rejection.

P. 72, *Ibid.*

Cleft Palate and Harelip are a pair of related constitutional defects. In the occupational series they are found most commonly in the native white agricultural group of the North (0.88). They are relatively less common among the Negroes (0.35) and in the commuter group, also 0.35. In the mountain groups the ratio is fairly high (0.59) and relatively low in the dessert group (0.33). Among the different races the Finns show the highest defect rate (1.1), while the different German groups have a relatively small defect rate (varying from 0.47 to 0.67).

P. 310.

TABLE 185.—CLEFT PALATE AND HARELIP

Groups	Total Cases	Ratio per 1,000	Ratio per 1,000 cases in groups
Agricultural native white, North, 73 per cent. plus	177	0.88	1.65
Agricultural, foreign and native white	191	0.65	1.24
Agricultural, native white, south,	265	0.62	1.19
Agricultural, Negro, 45 per cent. plus	63	0.35	0.63
Eastern manufacturing	114	0.51	0.86
Commuters	26	0.35	0.65
Mining	48	0.51	0.88
Sparsely settled, 3 or less per square mile,	18	0.41	0.70
Desert	4	0.33	0.49
Maritime	10	0.50	0.73
Mountain	31	0.59	10.3
Mountain whites	42	0.58	10.2
Indian, sparsely settled	27	0.85	1.60
Mexican, sparsely settled	14	0.51	1.07
Native white, Scotch origin	38	0.70	1.45
Russian, 10 per cent. plus	29	0.76	1.29
Scandinavian, 10 per cent. plus	113	0.72	1.33
Finns, 10 per cent	15	1.10	2.12
French Canadians, 10 per cent. plus	71	0.77	1.12
German and Scandinavian, each 10 per cent. plus	66	0.67	1.30
German and Austrian, 20 per cent. plus	47	0.47	0.93
German and Austrian, 15 per cent. plus	186	0.53	0.98

Group I (Agricultural, North, Native white, over 73 per cent.) exceeds all others in congenital defects, such as curvature of the spine, epilepsy, defective speech, deaf-mutism, deformities of the spine, muscular atrophy and cleft palate.

P. 280.

EUGENICS

During the past decade the subject of eugenics has been receiving more attention from scientific men than in any other period of time. Through the medium of the Eugenics Record Office, Cold Springs Harbor, Long Island, every phase of the subject is under investigation and careful reports of their findings are published from time to time. Through the personal work of Mr. William F. Blades of the Association, I have gathered much valuable information and have given to him the pedigrees of many families with congenital defects.

It has been my habit, when a child is brought to me suffering from a congenital deformity, to look into the family history carefully. The first question asked is "Is this the only child?" If there are others "Are any of them similarly afflicted?" "Has the defect existed in any of the grandparents or among their brothers and sisters?" "Have any cousins or

other relatives had cleft lip and palate?" From the information acquired, the question of heredity of parents, grandparents and other near relatives may be settled.

It is not possible in this book to record all the results of my findings. A few are published here, which point out the prevalence of inherited conditions. The general opinions expressed regarding heredity have been conjectural largely. The work of the Eugenics Record Office must impress even the layman's mind with the unquestionable influence which a congenitally defective parent exerts upon his child. Elsewhere in this book I have expressed my belief that heredity is a powerful influence in causing cleft lip and palate. The systematic work, scientifically conducted by the Eugenics Record Office, their facilities for tracing pedigrees and recording statistics will be of inestimable value in the study of congenital deformities.

What is Eugenics?—To understand what is to follow, it is necessary that we have a knowledge of what eugenics is. In a valuable treatise by Charles Benedict Davenport, entitled "Heredity in Relation to Eugenics," we find the following: "Eugenics is the science of the improvement of the human race by better breeding, or, as the late Sir Francis Galton expressed it, 'The science which deals with all influences that improve the inborn qualities of a race.' The eugenical standpoint is that of the agriculturist who, while recognizing the value of culture, believes that permanent advance is to be made only by securing the best 'blood.' Man is an organism, an animal, and the laws of improvement of corn and of race-horses hold true for him also. Unless people accept this simple truth and let it influence marriage selection, human progress will cease. Eugenics has reference to offspring. The success of marriage, from the standpoint of eugenics, is measured by the number of disease-resistant, cultivable offspring that come from it. Happiness or unhappiness of the parents—the principal theme of many novels and the proceedings of the divorce courts—has little eugenic significance, for eugenics has to do with traits that are in the blood, the protoplasm."

Among the statistics I have gathered in my own practice, I publish the following few cases:

Fig. 464 represents the family tree of patient E. S. on whom I operated in 1886 when she was ten days old. This patient had a double cleft lip, the premaxillæ protruded and there was a wide cleft of both hard and soft palates. I was able to follow the history of this patient until her death, at the age of twenty-one. This girl grew to be a very attractive young lady, with perfect speech and with unusual skill in vocal music. In this family there were ten children. The first, a girl, was normal. The second, a girl, had single cleft lip, which I operated. The third, a boy, had

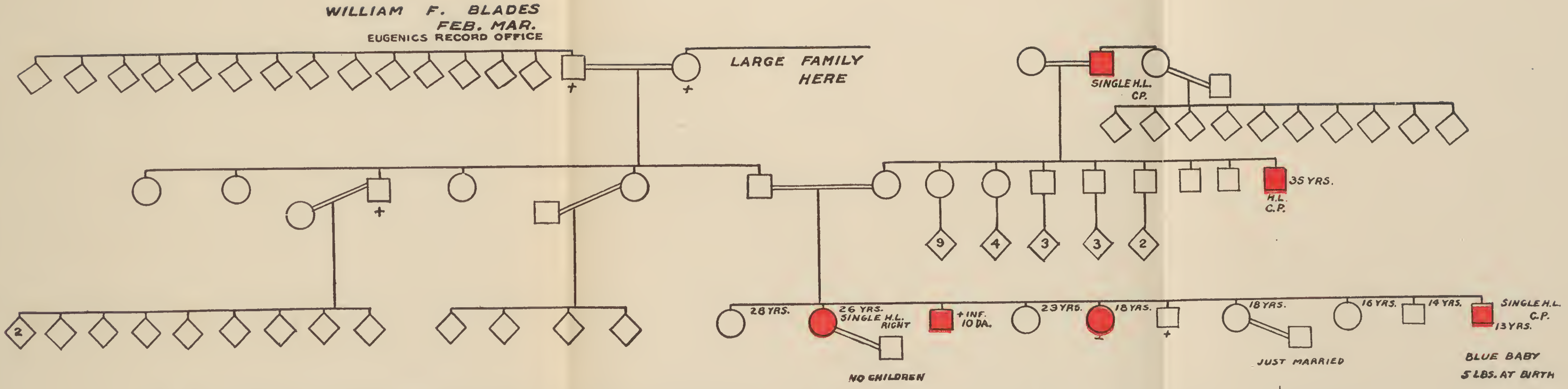

FIG. 464.—Chart of E. S. family showing (in red) the distribution of cleft lip and cleft palate. □ = male. ○ = female. ◊ = sex unknown. □═○ = parents. ┬ ○□○○ = offspring.

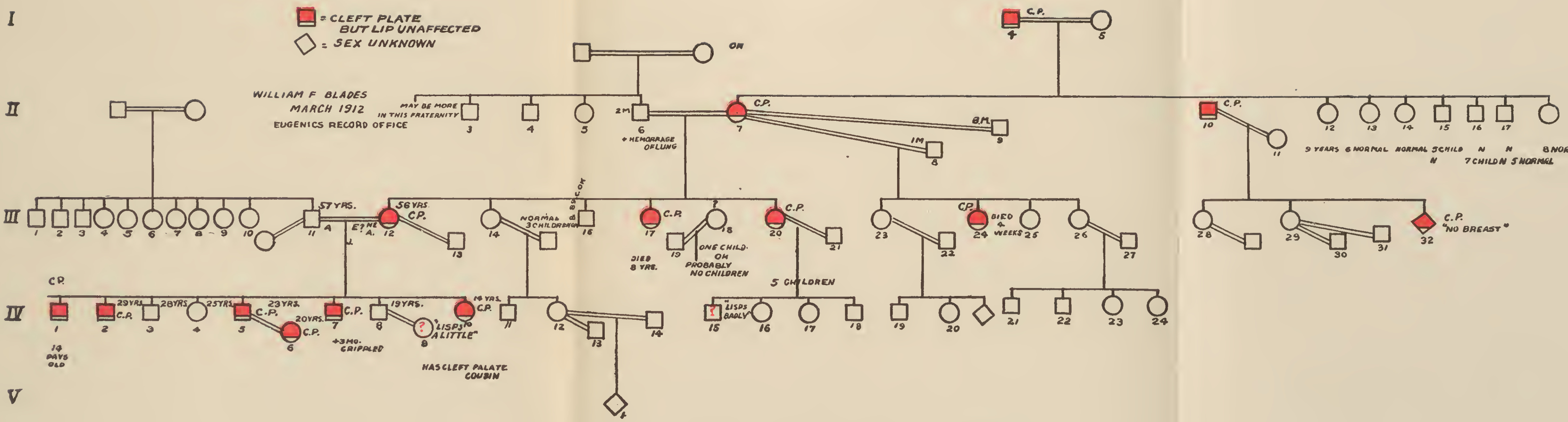

FIG. 465.—P. N. H. family. Cleft palate. (For legend, see Fig. 464.)

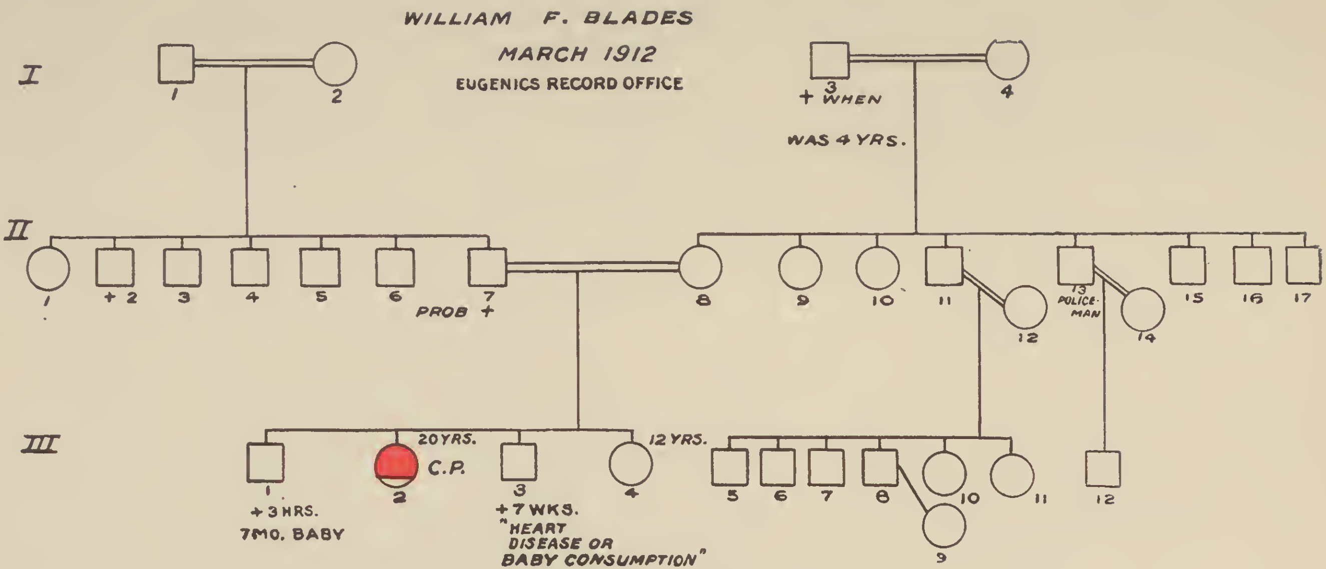

FIG. 466.—A. M. family. (See legend to Fig. 464.)

a double cleft lip and palate. He died without an operation when he was ten days old. The fourth was a girl, normal, and the fifth had a double cleft lip and palate. I also operated upon her. The sixth was a boy, the seventh a girl, the eighth a girl, the ninth a boy, all normal. The tenth, a boy, had a single cleft lip and palate. This boy was operated upon by me when he was three months old. The parents of these children were normal, but a brother of the mother had a cleft palate and cleft lip. The mother's father was also affected with a cleft lip and cleft palate.

Mr. Blades, who investigated this family, furnishes me with the following report: "Examined the palate of the father of these children and found it well rounded and, possibly, slightly high. The mother's palate is much higher than her husband's, but there is no defect. The ninth child has a palate higher than its mother's. The arch extends up to an unusual height. The tenth child has a high palate, the cleft and harelip have been closed." The other children were not examined by Mr. Blades. The mother told him that her youngest brother and her father had cleft palate and cleft lip. She attributed the condition of her defective children to inheritance from their grandfather. She stated that she had never permitted her mind to dwell much on such possibilities during pregnancy and knew of no maternal impression of any kind. She had always eaten well and had never lived upon any peculiar diet. Her taste in food was normal and like that of the average individual. She suggested that, in the second month of pregnancy for the first child affected, her father dropped dead suddenly. The parents stated that all the affected children had bad, easily decayed teeth. They were slow in development. The fifth child (the one described above) weighed four pounds at birth. The tenth child was a blue baby and weighed five pounds at birth. The mother said that all the affected children were smaller when they were born than those not affected. These children were all unusually attractive physically.

The parents were born in northern Germany and lived only a few miles apart. They never heard of any blood relationship between them. The history on the father's side is very meager, yet he declared that cleft palate and cleft lip were unknown in his family. The father is a sturdy, healthy man, a brick mason by trade. The mother is also in excellent physical condition.

In 1905 I was invited to give a surgical clinic at a meeting of the Northern Indiana Dental Society at Logansport. Arriving at the hospital, I found two patients suffering from cleft palate. The mother, Mrs. P., who also had a cleft palate, was with them. Upon inquiry, the most remarkable family history, so far as this deformity is concerned, was revealed. The question of heredity cannot be settled by a single family history. The deformity occurring so frequently among the descendants

of the grandfather of the child upon whom I operated would, I think, convince the most skeptical that the influence of heredity is most impressive. The pedigree herewith appended (Fig. 465) gives the details. It will be seen that the grandfather of the child had a cleft palate. He had a son and a daughter, among nine children, who were similarly defective. The son had three children, one of whom had a cleft palate. The daughter married a man whose family, so far as history records, was free from the defect. Three of her six children had cleft palates. After the death of her first husband, she married again and bore four children, one of whom had a cleft palate. The history of her second husband was good, so far as obtainable. Thus, of her ten children, four had cleft palates. The oldest daughter, who had a cleft palate, married a man who had ten normal brothers and sisters. The father and mother of these children were normal. The results of this union were eight children—six boys and two girls. The oldest girl was the fourth child and the youngest was the eighth. The first, second, fifth and sixth sons and the second daughter had cleft palates.

It is interesting to note, in the third division, that the fifth son, who had a cleft palate, married a woman who, also, had a cleft palate. So far as history records, the woman's family were free from the defect. The sixth son married a woman who lisped and was supposed to have a cleft palate. A cousin of this woman had a cleft palate.

In tracing a pedigree, we gather information only so far as history or tradition records; beyond this we know nothing. When congenital defects occur with frequency in different branches of a family, in my opinion there is no doubt that such defects have existed in progenitors, if not immediate, in those remote. In evidence of the foregoing, I submit the pedigree on p. 309.

It will be noticed that, in a family of three brothers, the first was married twice. In the three generations of the descendants of his first wife, nine members, there was no defect. Of the descendants of the second wife there were five, three sons and two daughters. The second son, normal, was the father of a child with congenital double cleft lip and cleft palate. Of the six children born to the fifth son, the second one was the father of a child with double cleft lip and cleft palate. Another brother of the progenitor first referred to had one son and one daughter. The son had a cleft palate and double cleft lip. The daughter was normal. She had five children; the first had a cleft palate and double cleft lip, the second had a single cleft lip and the third had a single cleft lip. The fourth and fifth were normal.

"Admitting, as we must, the importance of hereditary tendencies in determining man's physical traits, his behavior and his diseases, we cannot

overlook the question that must occur to all—What relation has the fact of heredity to those of environmental influence, to the known facts of infection and bad conditions of life? Indeed, were we to accept the teachings of some, environment alone is important; good training, exercise, food and sunlight can put anybody in a 'normal' condition.

"So long as we regard heredity and environment as opposed, so long will we experience endless contradictions in interpreting any trait, behavior or disease. The truth seems to be that, for human phenomena, there is not only the external or environmental cause, but also an internal or personal cause. The result is, in most cases, the reaction of a specific sort of protoplasm to a specific stimulus. For example, the controversy as to the inheritableness versus the communicableness of 'the itch' receives a simple solution if we recognize that there is an external agent, probably a parasite, that can, however, develop only in persons who are non-immune. Since such persons are rather uncommon and the absence of immunity is inheritable, the disease tends to run in families and can rarely be caught, even through inoculation, by persons outside such families. Even in cases where the hereditary factor is universally admitted, as in depressive insanity, the onset of the symptoms, may be delayed by very favorable conditions of life. However, though such symptoms may be diminished and the patient discharged from the hospital as 'cured,' yet the weakness in his germ plasm is not removed and will, unless he is fitly mated, show itself in his children when they, in turn, experience an unusual stress. The fungue tendency of the child of three years might not have expressed itself so acutely had he lived in the country, with freedom to wander widely at will, instead of being restrained within the confines of city houses and narrow streets. In extreme cases, however, of which complete albinism is an example, the trait seems to be due to the entire absence in both of the united germ cells of any determiner for the character. Under these circumstances, not even the best of environmental conditions can bring about pigmentation. Albinism is a protoplasmic 'accident,' as independent of environment as drowning by the overturning of an ocean steamship is independent of heredity. With few exceptions, the principle that the biological and pathological history of a child is determined both by the nature of the environment and the nature of the protoplasm may be applied generally."[1]

The above facts seem to strongly indicate the influence of environment as a factor in the etiology of congenital defects. Experience, based upon many years of observation, first led me to wonder why so many patients suffering from congenital cleft palate and cleft lip came from the same community. In view of the conclusions reached by students of eugenics, I am

[1] Davenport book on Heredity.

satisfied that these defects are endemic. The town of Bay City, Michigan, furnishes the most striking example of the truthfulness of the above conclusions. I am informed by Professor Lyons of Ann Arbor that thirty-two people in this town of 45,166 inhabitants were found to have congenital cleft palate and cleft lip. In the town of Blue Island, Illinois, nine patients were brought to me within three years.

3 Brothers
One Bro. Name Not Knonw

OK

First Wife

1st Son
1 Son Perfect

1st Son OK

1st Son OK Married No Children | 2nd Daughter OK Married No Children | 3rd Son OK

2nd Daughter OK Dead

3rd Son OK Married No Children

2nd Son OK

Second Wife

1st Son OK

1st Son OK 3 Daughters All OK | 2nd Daughter OK 4 Girls 1 Boy OK | 3rd Son OK 2 Daughters Both OK

2nd Son OK 1 son Not Married

3rd Daughter OK 1 Son OK

4th Daughter OK 1 Son OK

Cleft Palate, Double Cleft lip.
Operated at Hahneman Hospital at 1 year.

5th Son OK

1st Son OK Still Born | 2nd Son[1] 1st Son OK 2nd Daughter | 3rd Daughter OK 1st Son OK 2nd Daughter OK | 4th Daughter OK 1st Daughter OK | 5th Daughter OK 1st Son OK 2nd Son OK | 6th Daughter OK 1st Son OK

OK

Son Cleft Palate Double Cleft lip

Daughter
OK

1st Cleft Palate Double Cleft lip | 2nd Single Cleft lip | 3rd Single Cleft lip | 4th OK | 5th OK

[1] H. C. K. had Cleft Palate, Double Cleft lip.
Operated at 1 year. By Dr. McLean at Ann Arbor, Mich.
Operated at 7th year at Hahneman Hospital, Chicago.
Operated at 35th year. By Dr. T. W. Brophy at Los Angeles, Cal.
Dr. King's father and mother both healthy and rugged.
The mother does not remember any fright, hurt or strain while carrying child.
The mother had two front teeth filled before she knew she was pregnant.

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This extensive bibliography has been prepared to cover the time from the period of Celsus, 42 B. C.–37 A. D., to the present. I realize that there may have been publications in journals not accessible for reference and, therefore, many valuable papers on these subjects may have been omitted.

It will be of interest to the profession to note that a great physician, a man whose versatile mind led him into research outside the domain of internal medicine, of which he was a master, is listed herein. Dr. N. S. Davis, the founder of the American Medical Association, I find wrote two papers, the first being published in 1841 in the American Journal of Medical Science, Philadelphia, on "A Case of Congenital Harelip," and the second published in the New York Medical Journal, 1847, on "A Case of Double Harelip."

The Author.

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